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THE ROMANCE OF THE SEASONS

THE POND IN SUMMER

[*Frontispiece*

THE ROMANCE OF THE SEASONS

BY

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AUTHOR OF

"OUR INSECT FRIENDS AND FOES," "DENIZENS OF THE DEEP," ETC.

WITH FIFTY-ONE ILLUSTRATIONS FROM ORIGINAL PHOTOGRAPHS BY THE AUTHOR

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PART I

SPRING AND ITS STUDIES

"And the Spring arose on the garden fair,
Like the Spirit of Love felt everywhere;
And each flower and herb on Earth's dark breast
Rose from the dreams of its wintry rest."

SHELLEY.

THE
ROMANCE OF THE SEASONS

CHAPTER I

DEMETER AND PERSEPHONE

"Of thee, the great Earth-Mother, thee, the Power
That lifts her buried life from gloom to bloom."
TENNYSON.

ONE of the most beautiful and deeply interesting of the old Greek Nature myths is the story of Demeter and Persephone. Beautiful in its human passion of maternal love, there underlies this old-world myth another and more subtle story, the story of the Passage of the Seasons—Spring, Summer, Autumn, Winter—and of that wondrous all-pervading Influence, which reawakens from their death-like winter sleep the trees, and quickens into life the dormant seed.

This old Greek story tells how the fair maid

Persephone loved to wander through the fragrant fields of Enna, gathering flowers. Daughter of Demeter and Jupiter, she was not only wise, but of great beauty, and of so sweet and gracious a disposition as to be beloved by all who knew her. And so, wandering amidst the flowering meadows, and along the banks of the limpid streams which surround the plains of Enna, Persephone, fairest flower of all, passed the opening years of her life, childhood giving place to perfect maidenhood, until one day the fair isle of Sicily was shaken by a great earthquake, and from the gaping jaws of the riven earth, dark Pluto rose from out his dim kingdom of the Under-World to seek a bride. Vainly had Pluto sought a consort, but none would say him "yea," none would queen it with him in Hades, so that at last he had resolved to take by force that which was denied to his solicitations. Small wonder, therefore, that the heart of this grim Ruler of the Under-World should be filled with wild desire, the instant that he set eyes upon the beautiful Persephone, her arms filled with freshly-gathered flowers, as she wanders with her maidens through the peaceful fields of Enna, all uncon-

scious of impending danger. Swiftly Pluto approached, and seizing Persephone, despite her frantic cries and struggles, carried her, locked in his powerful embrace, to his chariot, and setting his horses to the gallop, departed with his stolen and unwilling bride. That none might know or follow whither he and his captive had retreated, Pluto smote with his trident the waters of Lake Cyane, which, parting wide, gave passage for his chariot to draw downwards to the Under-World; then, closing, left no token of his path.

Demeter, the great Earth-Mother, now mourns the loss of her daughter, and wanders all over the world seeking vainly for her child. Her sorrow is communicated to every living thing, so that the face of the country becomes desolate, and—

> "My quick tears kill'd the flower, my ravings hush'd
> The bird, and lost in utter grief I fail'd
> To send my life thro' olive-yard and vine,
> And golden grain, my gift to helpless man.
> Rain-rotten died the wheat, the barley-spears
> Were hollow-husk'd, the leaf fell, and the sun,
> Pale at my grief, drew down before his time."

So in the wild wailing of the Autumn and Winter gales, we hear the heartbroken,

questioning cry of the Mother, as she passes across the lonely country in the dark, chill night—

> "and forth again
> Among the wail of midnight winds, and cried,
> 'Where is my loved one? Wherefore do ye wail?'
> And out from all the night an answer shrill'd,
> 'We know not, and we know not why we wail.'"

At last Demeter learns that Persephone has been carried off by the dark god Pluto, and become Queen of the Under-World. For the return of her ravished daughter, Demeter frantically appeals to Jupiter, who, after vainly seeking to soothe the Mother's grief, at last partly yields to her pleading, promising that provided Persephone had not eaten anything during her captivity in the kingdom of Pluto, she should return to the Upper-World and have perfect freedom. But Persephone had gathered a pomegranate as she walked through the Elysian fields, and had been seen by spying Ascalaphus to partake of the fruit. Seeking advancement, Ascalaphus informs his master, Pluto, of what he has witnessed, and so renders the return of Persephone to perfect freedom impossible. But the spying rascal reaps just and swift punishment for his meanness,

Persephone sprinkling water upon his head and turning him into an owl.

Once more Demeter appeals to Jupiter, who, although now powerless to grant her daughter perfect freedom, decrees that she shall return to her mother for part of each year—

"Then He, the brother of this Darkness, He
Who still is highest, glancing from his height
On earth a fruitless fallow, when he miss'd
The wonted steam of sacrifice, the praise
And prayer of men, decreed that thou should'st dwell
For nine white moons of each whole year with me,
Three dark ones in the shadow with thy King."

The long quest ended and her petition granted, Demeter prepares to welcome her beloved one on her return from the Under-World. Once more she sends her life into the dormant seeds and buds, so that the whole earth stirs at the approach of Persephone. What more perfect picture can we have of Persephone's return than is contained in the following lines from Tennyson's exquisite poem?—

"Faint as a climate-changing bird that flies
All night across the darkness, and at dawn
Falls on the threshold of her native land,
And can no more, thou camest, O my child,
Led upwards by the God of ghosts and dreams,
Who laid thee at Eleusis, dazed and dumb
With passing thro' at once from state to state.

Until I brought thee hither, that the day,
When here thy hands let fall the gather'd flowers,
Might break thro' clouded memories once again
On thy lost self—

. . . . . .

So in this pleasant vale we stand again,
The field of Enna, now once more ablaze
With flowers that brighten as thy footstep falls.

. . . . . .

For, see, thy foot has touched it; all the space
Of blank earth-baldness clothes itself afresh,
And breaks into the crocus-purple hour
That saw thee vanish."

Thus, the close of this old-world legend, fragrant with the breath of Spring and the return of joyous life. Onward through the advancing seasons we may trace the footsteps of Demeter and Persephone, as they wander through the happy flower-clad fields of Summer, until the close of harvest-time and the contrasting tints of Autumn give warning of the approaching time when Persephone must once more depart to reign for "three dark moons" as Queen of the Under-World. Then as she passes to Pluto's dim kingdom, the sorrowing voice of Demeter comes to us on the wings of the Autumn gale, while passionate rain-storms sweep over woodland and valley, tossing the branches, scattering the dead leaves

until they fall in drifts of brown and gold, hiding the black scar where the earth had opened to make passage for departing Persephone. Soon the sky grows cold and grey, and softly the downy snowflakes fall, covering all the earth with a pure white mantle, beneath which—

> "Winter, slumbering in the open air
> Wears on his smiling face a dream of spring!"

Here, then, in this old Greek story runs a perfect cycle of the Seasons. It is indeed a legend beautiful, and one to cherish in the heart and think upon, for, like an ancient gem of perfect workmanship, its depths of crystal purity hold many an unsuspected secret beauty.

CHAPTER II

THE FLOWERS OF SPRING

"The winds are sleeping,
And through a thin-wove veil of silver-grey
The sun is like a timid lover peeping,
Where Hope in her own garden stands and sings,
And gazing upward hears the skylark chiming
Wild responses to her song——"

FREDERICK TENNYSON.

THE first weeks of the New Year are often ushered in to the accompaniment of the clanging music of naked, storm-tossed branches, as the wild wintry gales sweep through the woodland and across the open country. Then, as February steals upon us like a shy yet wilful maiden, there comes a succession of quiet days with silvery morning mists, through which "the sun is like a timid lover peeping." The air is still and soft, and sweet, and there is a sensation of hidden joy and expectation abroad, as one wanders down the country lanes towards the edge of the woods. There is a feeling of intense relief, as if the burden of some great

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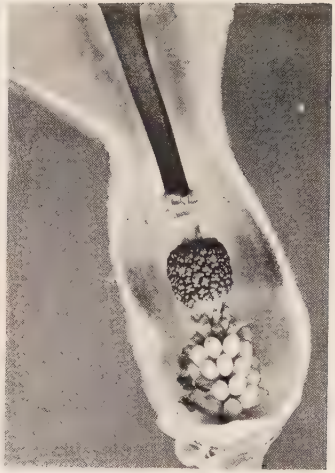

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1. THE GREEN SPLASH ON THE SNOWDROP'S PETAL IS A HONEY-GUIDE FOR THE BEES
2. THE GNOME-CAPS OF THE CUCKOO-PINT. 3. SPATHE OF CUCKOO-PINT CUT OPEN, SHOWING THE IMPRISONED MIDGES, AND CLUSTERS OF SIMPLE FLOWERS AND HAIRS

[*To face p.* 10

sadness, some dark shadow had been lifted, so that the heart is filled with gladness, thankfulness for that unspoken message of hope and promise of the brighter days to come. And that glad song which Hope is singing in the garden of our heart on such a quiet, sweet morning in early Spring, might always echo in our ears, stirring and encouraging us through the stony ways of life, if we would but see to it that the rank cruel weeds of spiteful jealousy, greed, selfishness and hatred made no vile growth within our heart to choke and drive away for ever gentle Hope and Love.

"Kind hearts are more than coronets,
And simple faith than Norman blood."

Demeter the great Earth-Mother is calling; calling to us on such a morning to go forth and wander with her for a while by hedgerow and through leafless copse, that we may see the first stirring of awakening Spring. Here on a sheltered bank

"Wavers on her thin stem the snowdrop cold,
That trembles not to kisses of the bee."

Only that second line sometimes does not come quite true, for a sudden burst of warm sunshine may awaken the hives and send the Bees forth

eagerly to the Snowdrops, so that their pure, white, drooping heads are set a-nodding and swinging, as the busy insects seek for the honey and pollen within each flower.

Coming so early in the year, the little Snowdrop with its pendent flower, which, save for the soft splash of green upon its petals, is of such pearly whiteness, has very often to brave the most inclement climatic conditions, so that but for the perfect way in which it has adapted itself to the season of its flowering, it would long ago have ceased to exist. At first the flower-stem grows straight upwards and erect, so that the unopened flower-bud points to the sky; but gradually, as the bud matures, the flower-stalk begins gracefully to curve and bend over, so that when the flower opens it hangs down from the stem like a little silvery white bell, and the pollen is thus perfectly protected from rain by the outer, pure white perianth leaves, which during cold wet weather remain closed. In fine weather the flower opens about ten o'clock in the morning, and closes for the night at about four o'clock in the afternoon. Like many other plants producing only a single flower in the season, the Snowdrop persists

fresh, and opens daily for a considerable time, so that although unfavourable weather may prevail when the flower first opens, it may, ere its petals fade, have the chance of receiving the visits of insects. The honey which the Bees seek is formed in the parallel longitudinal grooves on the inner side of the three outspread perianth leaves, while the simple, rigid points depending from the free extremities of the anthers, are in such a position that the visiting insect cannot help coming in contact with them and receiving a portion of the pollen, which is in due course rubbed off on to the viscid stigma of the next Snowdrop the insect visits. Should the Snowdrop, however, be unable to secure the benefit of cross-pollination through the visits of the Bees, owing to prolonged bad weather, then towards the close of the flowering period the anthers relax, or become dislocated in such a way, that the mealy pollen falls upon the still receptive, viscid surface of the stigma; which thus becomes pollinated by the pollen from its own flower, so that the setting of the seed is assured.

Another interesting little plant of early Spring, and one that completes its whole life-

cycle within the space of a few weeks, is the little Whitlow Grass (*Draba verna*), a diminutive member of the great Crucifer family. It loves to grow upon the top of old mossy walls and sheltered banks, and should the weather be favourable, three to four weeks will compass the whole of its life, from the first spreading of its tiny leaves to the scattering of the ripened seeds. Early in Spring we may see the ovate, somewhat oblong little leaves of the Whitlow Grass spreading out like a rosette, and pressed closely to the ground for warmth, and for shelter from the cold driving squalls of rain and sleet, and the bitter winds. About ten days after the foliage leaves mature and spread their rosette against the ground, a tiny, slender, leafless flower-stem, rarely exceeding three inches in height, rises from out the centre of the rosette. The flower-buds soon expand, revealing the tiny white petals, four to each flower, and so deeply cleft that they might easily be mistaken to number eight. Then when we seek the little plant upon a bright and sunny morning, we shall see that its wide-open flowers are being visited by many very tiny midges, who are very busy going from one

blossom to another, attracted by the white petals, and in their visits carrying the pollen from the stamens of one flower to the stigmas of another. After this process of pollination has taken place, the seeds rapidly ripen within the small, flat seed-capsule, which soon opens and, swaying in the wind, scatters the tiny seeds upon the ground, where they will lie dormant until the early days of the following Spring. The seeds once scattered, the little plant soon dies, having completed its life-cycle safely before any larger plants have advanced their new growth sufficiently to crowd or overshadow it. By this means, throughout its short life, the little Whitlow Grass has been able to enjoy the maximum amount of light, air and space in which to grow and perpetuate its species.

"What time the
Winds are east and violets blow,
And slowly stalks the parson crow,"

we may see growing upon waste ground and railway embankments the yellow flowers of the Coltsfoot. At present there is no trace of foliage, only the stout scapes or flower-stems, covered below by short purplish scales, and

each stem crowned by its large and rather fluffy-looking yellow flower-head. When we examine the flower-head, we see that the Colts-foot belongs to the Composite family, for its flowers are collected together into a head, as is the habit with the members of this family of plants; the outer or ray-florets being very narrow and numerous, give to the flower-head its fluffy appearance. Not until the flowers have all been pollinated, the seeds set, and the yellow heads have changed to white feathery down which, on the ripening of the seeds, helps to carry them away on the wings of the wind, do the foliage leaves begin to appear; so that during the whole of the flowering and seed-distributing period, the ground is bare, and there is nothing to attract the attention of the first flower-haunting insects of the year from the golden flower-heads of the Coltsfoot. The large angular leaves then rapidly appear and make a most luxuriant growth, each leaf attaining some five or six inches in diameter, covered on the under-surface with a thick white woolly felting. In the old days of flint and steel, before the invention of the so-called safety matches, this woolly felting was often used for

tinder. Its use to the plant is to prevent the excessive deposition of dew, for the Coltsfoot loves damp clayey places where heavy dew is deposited nightly during the summer, and this woolly felting off which moisture rolls in little round drops, prevents the dew clogging up the tiny stomata or evaporation pores, which we shall have an opportunity of examining later on in the year when all the trees are decked in summer foliage.

A near relation of the Coltsfoot is the Butterbur (*Tussilago Petasites*), which in its way is also a rather singular plant. In the early Spring, though not quite so soon as the Coltsfoot, it sends up from its subterranean root-stock a very substantial flower-stem, which, when full grown, may attain to twelve inches in height, covered with many flower-heads of a dull pinkish-purple colour; its general shape somewhat reminding us of a dense flower-spike of the Horsechestnut; only here, the single flowers of the Horsechestnut are replaced by fairly dense, composite flower-heads. These flower-spikes, with their pinkish-purple flower-heads, last for some time, indeed until Spring has well advanced, and then as they begin to

disappear, the foliage stems push upwards through the ground, and the leaves unfurl. The leaves are very similar in appearance to those of the Coltsfoot, but they attain to a much greater size, frequently reaching three feet in diameter, casting so much shade, and making such luxuriant growth, as to overpower all other plants in their vicinity in the struggle for existence. Although at this later, leafy stage the Butterbur is often a pestilent weed, its early flowers do good service in providing honey for the Bees at a time of the year when flowers are far from numerous.

And now, as Spring advances, the winds grow busy with new duties, for as they sweep by hedgerow and through copse, they carry on their wings a precious burden of pollen from tree to tree, and plant to plant; for many are the inhabitants of the Plant World which in the Springtime of the year depend upon the wind to transport their pollen. The Oak, the Pine, the Birch, the Beech, the Alder and the Hazel are all Spring-flowering trees dependent on the wind, and not upon the visits of insects, for the transportation of their pollen. Bright colours, sweet scents, honey, delicate mechan-

isms are all unnecessary when the winds acts as carrier. Of the heavens free, it neither asks nor accepts payment for its labours. But, as "the wind bloweth where it listeth," those plants and trees which depend upon its services must needs have an abundant supply of pollen, for much may be carried off in the wrong direction by some thoughtless wandering zephyr. So we shall find when we come to examine them closely, that those plants and trees which depend upon the wind as carrier, have great abundance of dry and dusty pollen, and very simple, small, and unpretentious-looking flowers, generally greenish in hue; and that the pollen and seed-producing organs are not present in the same flower, but are separate, and may not be produced on the same plant. Such is the case, for instance, with the Dog Mercury, one of the very earliest of the hedgerow plants to flower. Here the pollen-bearing male organs (stamens) are borne on one plant, which is said to bear "staminate flowers"; and the seed-producing female organs, the "stigmatic" or "pistilate flowers," upon another. When we wander along the hedgerow or through the copse in early Spring, we shall find

plenty of colonies of the Dog Mercury, and we shall see that the male and female plants grow in groups not very far from one another, so that the wind has not to carry the dry and dusty pollen for any great distance from the stamens of the male flowers to the stigmas of the female flowers.

According to that great botanist and true lover of Plants, Anton Kerner von Marilaun, "it would not be far out to put the number of wind-pollinated plants at 10,000, *i.e.* at about a tenth of the total number of Phanerogams (flowering plants). To this category belong the Conifers, Poplars, Walnut-trees, Mulberry-trees, Planes, and the majority of the Palms. All these are of the nature of lofty trees, and usually grow in numbers together, each being associated with others of its own kind so as to form extensive woods or plantations, characterized by a close association of individuals." To these trees must be added a large number of smaller plants, the grasses, cereals, sedges, reeds and rushes of the meadows, fields and marshland.

Many plants, when their flowers first open, have the parts of the flower so arranged as to

make successful pollination impossible except through the agency of insects, but later on a readjustment of the parts of the flower takes place, the anthers lengthen considerably, and then the wind acts as the carrier of their pollen. In such plants the double method of pollen distribution assures pollination taking place, and the object of flowering being attained.

In the case of trees like the Alder, Ash, Elm, Hazel and Birch, with dry dusty pollen, dependent upon the wind as carrier, we find them all flowering before coming into leaf, so that no obstacles may come in the way of the free dispersal of the pollen. It is obvious, that if these trees did not begin to bloom until after their dense foliage was completely developed, the wind-transported pollen would never reach the stigmas, owing to the innumerable natural barriers formed by the leaves. In the fir-trees, which are in leaf at the season of flowering, we find both male and female inflorescences placed in the most suitable situations to assure successful pollination; thus the extremities of the pendent lateral branches of the lower boughs bear the male inflorescences, whilst the

little cones, the female inflorescences, stand up on the top of the boughs fully exposed, looking like little green candles on a Christmas-tree, and therefore are in the best position to receive the wind-borne pollen. In some years, when the season has been peculiarly favourable to the development of the pollen, so large is the amount produced, that not only the cones and foliage of the Pines are dusted all over with it, but the undergrowth and paths are covered with a thick coating of pollen dust. There is a structural feature of very considerable interest about the pollen grains of the Scotch Fir (*Pinus sylvestris*), inasmuch that every grain has a tiny pair of oval outgrowths or wings, which undoubtedly play a very important part in helping to keep the tiny grain buoyant on the wind. If the grains were merely minute spheres, or were oval, oblong, or three-cornered in shape like the pollen grains of many insect-frequented flowers, they would have a natural tendency to sink earthwards during their passage through the air, and the effective area they could traverse would be greatly restricted; but these little "wings" not only help to buoy up the grains so that they remain longer

suspended in the air, but would appear also to have a lifting effect, giving the grains probably a spiral rotating motion during their passage through the air.

As we wander through a Hazel copse on a bright early March morning, we shall see the long, slender catkins gently swaying in the breeze, and if we touch them our fingers at once become charged with the golden pollen. Each catkin is really a collection of male flowers, each tiny flower being protected by a little brown scale, which serves to shelter the stamens from the rain and sleet. While the male flowers are thus grouped together in the form of pendent catkins, the female flowers will at first probably escape our notice, for they are inconspicuous and stand in a more or less erect position on the upper-side of the branches, looking like curious little buds, crowned with a tuft of feathery stigmas to catch the pollen.

The path through the Hazel copse leads us to a sheltered, sunny bank, where we are sure to find the first Lesser Celandine flowers of the year. And how early they come! February has scarcely departed ere they "out once more

in varnish'd glory shine," like little golden stars, giving a touch of hope and a promise of sunny days to come. It is a wonderful little plant in many ways, this Lesser Celandine, and one over which botanists have fought many battles, seeking to place it under this or that species according to their pet theory, so that in turning over the pages of botanical books by different authors, we shall find our little golden-flowered friend sometimes called *Ficaria ranunculoides*, sometimes *Ranunculus ficaria*. However, Sir J. D. Hooker considers it to be a Ranunculus, a true member of the Buttercup family, and the verdict of that great authority has now been accepted by most botanists. The little plant appears to have descended from some long-lost type of ancestral Buttercup which took to an aquatic life, but later on again established itself as a land-plant.

Let us examine this puzzling little Lesser Celandine, and see if we cannot make out for ourselves how it differs from the Buttercups of the summer fields and meadows. Picking one of its bright, burnished yellow blossoms, we see that the flower has three sepals instead of

five, and seven to eight petals instead of the constant number five, but that there are numerous stamens and carpels, the latter, should they ripen, becoming achenes, exactly in the manner of other Buttercups. The carpels do not always ripen, however, the plant increasing by the tiny oblong tubers formed at its rootstock. So we see that the flower is like, and yet somewhat unlike, that of a Buttercup. Again, the Lesser Celandine flowers long before the familiar Buttercups of summer; while its glossy leaves have an outline rather like an ace of hearts, somewhat resembling the leaves of a one-seed-leaved (monocotyledonous) plant called the Frogbit, and the whole plant is smooth. Should we carry our observations a little further, with the aid of a sharp knife and a powerful pocket magnifying glass, or, better still, a microscope, we shall then be able to see that sections of both the stem and leaf-stalk show the presence of those "air canals" which are characteristic of all water-plants; while a microscopical examination of the leaves will reveal a marked predominance of tiny "pores" or "stomata" on the upper surface, just as in the floating

leaves of a water-lily, which, however, has none on the under-side, as has the Lesser Celandine. Lastly, should we plant some of the seeds and watch their growth, we should find that they possess only one seed-leaf, and not two seed-leaves, or cotyledons as they are called. All these peculiarities point that the ancestors of the Lesser Celandine were aquatic plants, and that many, many years ago the Celandine returned once more to the land to live, and that although it has re-adapted itself to the changed environment of terrestrial and aërial conditions, it has not been able to throw off all the aquatic characters it acquired during the earlier period of its history, when its ancestors flourished as water-plants.

And now, as March gives place to April, the Spring flowers rapidly advance, so that almost every day sees the opening of new blossoms, and fresh buds unfurling. But a little while, and in the course of our morning ramble across the meadow and through the wood, we shall be able to find those sweet flowers for which Perdita sighed. She, too, knew the old legend, though she called Persephone by her Latin name—

"O Proserpina,
For the flowers now, that frighted, thou let'st fall
From Dis's waggon! daffodils,
That come before the swallow dares, and take
The winds of March with beauty; violets, dim,
But sweeter than the lid's of Juno's eyes,
Or Cytherea's breath; pale primroses,
That die unmarried, ere they can behold
Bright Phœbus in his strength."

Poor pale primroses! Methinks Perdita had in mind those too precocious firstlings of the year, that peep forth before the Bees are on the wing, from sheltered nooks about the season of Epiphany, what time Joseph of Arimathea's thorn bursts into bloom at ancient Glastonbury. These needs must "die unmarried," but not so their April sisters who make every copse and sheltered bank fragrant with their scent. The wonderful adaptation of the primrose to obtain cross-pollination through the visits of insects has been so frequently described of late, that only passing reference is necessary here. Have we not all gathered those "pin-eyed" and "thrum-eyed" primroses, and, perhaps, noted vaguely how only one kind of flower is to be found on each plant? Then, should we carefully open the pale blossoms, we shall see how in the pin-eyed type the round head of the

stigma stands at the entrance of the tube, while its anthers are arranged in a circle halfway down; and how in the thrum-eyed flower the positions are reversed, so that the insects wandering from one primrose to another must needs pollinate the thrum-eyed with pollen from the pin-eyed, and *vice versâ*.

The violet presents some points of interest which do not seem to be nearly so generally known as the specialization of the primrose. The delicate fragrance of the Sweet Violet (*Viola odorata*) is one of the delights of early Spring, while to find the first violets of the year is an annual joy that lasts throughout the longest life. One would imagine that the sweet-smelling, deep violet, or pure white flowers, so abundant where the plant is growing in suitable surroundings in the Spring, would be eagerly sought out by insects, and would have no difficulty in setting their seed. Yet, as a matter of fact, so few of these Spring blossoms succeed in maturing their seeds, that the Violet would soon totally disappear from our woodland banks, were it dependent upon these perfect, odorous blossoms for the perpetuation of its species. Indeed, for some

reason, the scentless flowers of the Dog Violet (*V. canina*), set a far higher percentage of seed. Both the Sweet and the Dog Violet, however, produce throughout the summer, long after their perfect blossoms have faded, another type of flower, small, petalless, bud-like in appearance, and incapable of expanding, but which is perfectly developed within, and pollinates itself. It is from the abundant seeds of these bud-like, self-pollinating flowers that the violets chiefly spring. The presence of these two totally distinct types of flowers is very interesting, and as the simple bud-like flowers are sufficient to continue the species, the duty of the complete and more attractive flowers of the Springtime would appear to be the all-important one of obtaining an occasional cross through the visits of insects.

The daffodils "that come before the swallow dares," must surely be counted among the most graceful and beautiful of our Spring flowers. Every year, unfortunately, in many districts where they were formerly to be found in profusion, they are becoming scarcer, owing to the wholesale and wanton digging up of the bulbs in the early months of the year, and later the

gathering of every blossom, chiefly by itinerant vendors of roots and flowers, so that neither by seed nor bulb can this lovely flower of our meadows increase. An old-world charm lingers round the flower and its homely country names, such as Daffy-down-dilly, once the theme of nursery rhyme, and Lent Lily, which is older still, and takes us back to the Middle Ages, when so many of our wild flowers were dedicated to the Virgin Mary. Lady's Smock, Lady's Mantle, Lady's Bedestraw and Lady's Slipper are all common plant names which, like the Lent Lily, have come down to us practically unaltered from the Middle Ages. Like so many of the Spring flowers, the graceful daffodils are with us for but a short period, and of their swift departure old Herrick sadly, sweetly sings—

"Faire Daffodils, we weep to see
You haste away so soone:
As yet the early-rising sun
Has not attain'd his noone.
Stay, stay,
Until the hasting day
Has run
But to the Even-song;
And, having pray'd together, we
Will goe with you along."

The beautiful deep-green, arrow-shaped leaves of our English Arum, better known, perhaps, by its more popular names of Cuckoo Pint, or Lords-and-Ladies, are noticeable in the hedgerow for many weeks before the pale gnome-cap spathes appear. Indeed, the Cuckoo sends his full-voiced call across the meadows ere the spathes, at first so tightly folded, appear. Were it not such a common wayside plant, the Cuckoo Pint would probably have long ago attracted more attention, and perhaps become a regular inhabitant of our gardens, for it is really a very handsome as well as a most interesting plant.

The gnome-cap of the Cuckoo Pint is not really any part of the flower at all, but is a protecting outer leaf, or spathe, as the botanists call it. As this protecting spathe grows and expands, we see within its folds a deep purplish-red coloured, club-shaped body standing upright, and which is the stem or axis bearing the curious tiny flowers hidden from view. This bright-coloured club acts also as a kind of barber's pole, or rather inn sign, to attract numerous very small midge-like flies, who are the carriers of the pollen from one Cuckoo Pint

to another. In addition to the coloured sign-post, the spathe, when ready to receive the visits of these insects, also gives forth a slightly-tainted odour which strongly appeals to them, so that they alight upon it and eagerly crawl away down inside. Note the shape of this spathe, and how it has a kind of waist and then broadens out again below, so as to form a kind of little chamber at its base. Having examined the external appearance of the Cuckoo Pint, let us carefully slit open the spathe, so that we can see the structure within. We shall find that on the club or sign-post, exactly where the waist of the spathe comes, there are a number of stoutish, downward-pointing hairs, which, although they extend outwards so as to touch on all sides the encircling walls of the waist, will, from their downward droop, permit any small midge to readily push its way past them from above. Immediately below these hairs, and on that part of the stem which passes through the chamber formed by the broadening out of the spathe below the waist-like constriction, the stem of the club is encircled by numerous tiny knobs, which are the male or staminate flowers. Below these, again, are the almost

egg-shaped female flowers, as primitive and devoid of petals as the males. If we have cut open a mature spathe, we shall find that there are a number of tiny midges, all more or less dusted over with pollen, crawling about within the chamber below the waist of the spathe. These are temporary prisoners or guests, who have come from a previously-visited spathe, from which they have brought the pollen with which they are besprinkled. It was easy enough for them to creep down past the hairs in the waist to the chamber below, but to make their escape again is practically impossible, for those downward-pointing hairs have considerable resisting powers, and form, with the waist, a kind of lobster-pot trap, so that for the time being the little insects are held captive. Now the female flowers are the first to mature, and the imprisoned midges in crawling about seeking for food or a way of escape, rub the pollen they have brought from another Cuckoo Pint, off their limbs and bodies on to the receptive stigmas of these flowers. When the female flowers have thus been pollinated, through the agency of the midges, by pollen from another Cuckoo Pint, the male flowers immediately

above them begin to mature, and shower down a quantity of pollen upon the midges, who feast upon it, and become dusted all over with it. Directly the stamens have showered down all their pollen, then the downward-pointing hairs, which up to this time have held the midges prisoners, wither away, the lobster-pot trap ceases to act, and the midges, making their escape, at once fly off to another Cuckoo Pint, where they again are held prisoners until they have performed their duties. Here, then, in this common wayside plant, we have a most perfect, yet comparatively simple arrangement for securing the benefits of cross-pollination through the visits of insects. If the stamens of the Cuckoo Pint were the first to mature, the pollen would fall upon the stigmas of the same plant, but as it is the stigmas which first ripen, the Cuckoo Pint makes cross-pollination a certainty. If we can induce some Cuckoo Pints to grow in our garden—and it is not very difficult to do so, provided they have a shady bank—we can carry out a simple experiment for ourselves to prove that the seed is only set by cross-pollination. All that is necessary is to enclose with finest muslin, before they begin

to open at all, some of the spathes, and to leave others unguarded. Then later in the year we shall see that only the stems we left uncovered are crowned with the familiar scarlet berries.

And now the full glory of Spring is with us, the woods are fragrant with the scent of the wild hyacinth, their glorious masses of blue flowers looking as if the woodland were carpeted with the deep-blue sky for the coming of Persephone, while—

> "The field is alive with grass and flowers,
> And wherever the flashing footsteps fall
> Of the fleet, ethereal April showers,
> The untouched earth laughs, overlaid
> With multitudinous blossom and blade."

CHAPTER III

NESTS AND NEST-BUILDING

Saint Valentine's Day, and in my garden a Throstle is pouring forth a perfect ecstasy of song, singing of

"Love again, song again, nest again, young again."

Hark to him!—

"Summer is coming, summer is coming,
I know it, I know it, I know it.
Light again, leaf again, life again, love again;
Yes, my wild little Poet."

And blithely, surely, he should sing, for is not this day, according to ancient tradition, the wedding day of all the birds! His flood of joyous song, floating in at my study window, brings a vision of the past, of a quiet plaisance beneath a Southern sky, where, on a certain Saint Valentine's Day long years ago, Francis of Assisi read to the birds a marriage homily. There is something very touching, very beautiful about that simple old-world story of the

THE NEST OF THE SONG THRUSH HAS A LINING OF MUD CEMENT

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gentle, kindly-hearted priest exhorting the little birds that he loved so well.

Already there are signs of nest-building in the garden, and before the month is out, should the weather continue clement, some of the Song Thrushes will have laid their first clutch of eggs. Have you ever considered the nest of a Song Thrush, or, for the matter of that, of any other bird, as a structure built by a comparatively frail creature, unschooled save for hereditary instinct, and without any tools save beak and breast and little slender feet? If you have once given it a serious thought, you must have been impressed by the beauty and ingenuity of it; and, I hope, touched by all that that woven Throstle's nest of twigs and grass-stems, with its wonderful smooth lining of cement-like mud means,—all the loving care and labour expended by the bird in the building of this wonderful receptacle for its precious eggs. Surely we should all strive to the best of our ability to prevent any wanton destruction of birds' nests? It should not be a difficult matter to impress boys and girls with a sense of the cruel and wanton injury they cause when they thoughtlessly rob and destroy

the nests during the Spring and early Summer. Let them look at the nests and learn to admire them by all means, but do try to make them realize what a senseless, jackdaw-like habit is the collecting of eggs for the mere sake of collecting something pretty; and that every egg taken represents the destruction of a precious life; every nest pulled down, means the wanton destruction of a home built with infinite patience and labour by an innocent, defenceless creature, and that these thoughtless acts cause irreparable injury and sorrow to the parent birds. To the boy, appeal to his sense of honour and manliness to protect the weak and innocent; while to the girl, you should be able to appeal and touch her innate sense of motherhood, and the sacredness of all that the simple word "home" should mean to her.

And now I am going to describe briefly a few nests, not very rare ones, or difficult to find, with the exception of two—those of the Long-tailed Titmouse, and the Reed Warbler—and I have selected these nests partly because of their beauty, partly because they are comparatively readily found, hoping that by draw-

ing the reader's attention to these more or less familiar nests, to awaken an interest in the structure of these wonderful and beautiful objects, and inspire a desire to prevent their wanton destruction.

About the first week in April we may find the Missel Thrush busy building its nest in the fork of a bough of some old, mossy apple-tree in the orchard or meadow. It is a substantial structure, the mud core not infrequently gripping the branch on each side with such firmness as to remain a conspicuous object long after the more perishable parts of the nest have vanished in decay. Externally the nest is chiefly composed of moss, tufts of dry grass, and stems woven together. The parent birds are very devoted and brave, and will dash round and round an intruder, uttering their harsh-sounding alarm note, so persistently as to beat off marauding crows and cats. Often on a dreary, tempestuous January afternoon, when the bitter squalls of rain and sleet sweep across the fields, and Spring seems very far away, the Missel Thrush, perched high on a swinging bough, sends forth his wild clear voice in a burst of exuberant song, as if he cared not one

whit for the wintry winds and leaden, drooping skies, his joyous little heart so filled with the glad promise of better days to come. Indeed, it is from this curious and pleasing habit of singing rapturously through such wild weather that the bird has gained one of its country names, that of the Stormcock. Though his song has neither the flute-like softness of the Blackbird, nor the variety and compass of the Throstle or Song Thrush, it has a wild, passionate freedom that sets the heart throbbing with delight. It is like some old Norse saga, telling of stirring times and mighty deeds. The Missel Thrush is a faithful little friend, and if undisturbed will return again and again to the same nesting site. We may lose sight of him in the Autumn, when that wonderful migratory instinct calls him southward, though he may not actually quit the shores of England, but the turn of the year sees him back again to gladden us with his wild and joyous song.

Whenever I see the dainty, shallow saucer of slender twigs, lined with a padding of fine fibrous roots and horsehair, which forms the nest of the Bullfinch, I always think of Ruskin,

and of the wonder and admiration with which he was filled on being shown a particularly beautiful specimen. But let him tell the story in his own expressive way :—

"The other day I was calling on the ornithologist whose collection of birds is, I suppose, altogether unrivalled in Europe (at once a monument of unwearied love of science, and an example, in its treatment, of the most delicate and patient art)—Mr. Gould. He showed me the nest of a common English bird; a nest which, notwithstanding his knowledge of the dexterous building of birds in all the world, was not without interest even to him, and was altogether amazing and delightful to me. It was a bullfinch's nest, which had been set in the fork of a sapling tree, where it needed an extended foundation. And the bird had built this first storey of her nest with withered stalks of clematis blossom; and with nothing else. These twigs it had interwoven lightly, leaving the branched heads all at the outside, producing an intricate Gothic boss of extreme grace and quaintness, apparently arranged both with triumphant pleasure in the art of

basket-making, and with definite purpose of obtaining ornamental form.

"I fear there is no occasion to tell you that the bird had no purpose of the kind. I say that *I fear* this, because I would much rather have to undeceive you in attributing too much intellect to the lower animals, than too little. The bird has exactly the degree of emotion, the extent of science, and the command of art which are necessary for its happiness; it had felt the clematis twigs to be lighter and tougher than any others within its reach, and probably found the forked branches of them convenient for reticulation. It had naturally placed these outside, because it wanted a smooth surface for the bottom of its nest; and the beauty of the result was much more dependent on the blossoms than the bird. Nevertheless, I am sure that if you had seen the nest—much more, if you had stood beside the architect at work upon it—you would have greatly desired to express your admiration to her."

And here let me give a timely word of warning about disturbing the surrounding foliage in endeavouring to obtain a better view of a nest.

Remember that there is a reason for the birds having built their nest in such a position as to be screened from view as much as possible. There are many hungry foes both furred and feathered, only too eager to rob the nest of eggs or young, should they espy it; and beside these ever-present dangers, there is another, and that is, that by the parting aside or breaking down of the natural screen, the direct rays of the hot sun may pour down hour after hour upon the luckless fledglings, and cause their untimely death. Therefore, should you attempt to part the branches of a bush or thicket, be careful that they are not broken, and that they are allowed to go back into their original position, so as to perfectly screen the nest and hide it from view.

The Chaffinch begins its nest-building early in April, and its nest may be found in various situations, for it will build among the old moss-grown orchard trees, in a growth of ivy, or a bramble patch. The nest is very smooth and compact, composed of green mosses mingled with grey down, wool and cobwebs; and is lined with hair and feathers, while its outside is often thickly spangled with grey tree-lichens.

Altogether, it is a very neat and beautiful structure. If we can take up a position at a little distance from the nest, when the fledglings are sufficiently advanced to have become restless, we can witness, with the aid of a good pair of field-glasses, their movements while awaiting the return of the parent birds. Ever and anon a quaint little head, crowned with fluffy down, will pop up above the edge of the nest for a moment and then disappear again from view, its place being taken by another hungry, anxious youngster, this jack-in-the-box performance going on until Mother Chaffinch arrives with her beak full of insect dainties for her offspring. A good, modern prism-glass such as the Zeiss ×8 or ×12, is a most useful, I might say indispensable, companion on our country rambles, for it enables one to watch every movement of many a shy creature at a distance at which it would be impossible with the unaided eye. The ×12 glass is my favourite, although it requires a steady hand, but the high magnification enables you to pick out individual plants growing on a bank or in the fields, and even to detect caterpillars feeding or moving among the stems and leaves.

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1. THE LONG-TAILED TITMOUSE BUILDS AN EXQUISITE NEST OF MOSS SPANGLED WITH GREY TREE-LICHENS. 2. THE LESSER REDPOLL WILL LINE HER NEST WITH DELICATE WHITE FEATHERS FROM THE SWAN'S BREAST

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The favourite nesting site of the Linnet is a furze-bush, and with the help of the prism-glass one may often watch the birds bringing their building materials to the spot they have selected in a quiet, unfrequented corner of some furze-covered common. At first the birds are busy with the pliable twigs, roots, and dry tufts of weeds, with which the outside of the neat and strong nest is built, a little moss being used to fill the chinks. Then the Linnets proceed to hunt for wool, hair, seed-down, and fine fibrous roots, which are collected and felted together to form a snug, warm lining to the nest.

One of the most remarkable and beautiful nests built by any British bird is that constructed by the Long-tailed Titmouse, in some scaly-barked furze-bush, or among thick thorns and brambles. In the first stage of its construction, the birds building from the bottom upwards, it looks very much like a half-finished Chaffinch's nest. Gradually the sides of the nest are built up, the wee birds at first working perfectly evenly at the mossy walls, but as the work progresses, one side of the nest begins to rise more rapidly than the other, and

is continued over the top, forming the dome of the nest, beneath which is the entrance hole. Moss is the chief material used in building the main structure, downy feathers for the warm lining, and lichens for the outside; the whole forming a little masterpiece of artistic construction. Should the nest, as not infrequently happens, be built in an ancient thorn hedge in April, while there are few or no leaves to screen it, disaster is pretty sure to overtake it, the first ignorant urchin passing down the hedgerow on wanton destruction bent, being certain to see it and ruthlessly pull it out. Yet in spite of this senseless destruction, the brave little birds will set to work again, probably quite close to the original site; and, very likely, gathering up some of the fragments of the old nest cast in the roadside, which had cost them so much trouble and labour to build, weave them into the new one.

Another truly remarkable nest is that built by the Reed Warbler, one that is not so readily come at as the Long-tailed Tits. It is slung above the surface of a quiet pool, in the middle of a reed-bed, between three or four of the reed-stems which pass right through the sides

of the nest, which has a very deep cup, and is so constructed that it rocks to and fro with the reeds as they sway in the wind, without any fear of injury to the eggs. The birds use the grey plumes of the previous year's reeds, weaving them round the supporting stems in the most methodical manner, and filling in the interstices with the cottony catkins of the willows and poplars, with a little moss, and perhaps some wool and horsehair. The parent birds are often victimized by the Cuckoo, who deposits her egg in their nest, with the result that their own offspring are all shot out of the nest by the baby Cuckoo, and they have to labour their very hardest to keep the foster-child supplied with food.

The Lesser Redpoll builds its nest in various situations, such as bushes, hedges and small trees, generally rather low down, and fairly well concealed. The birds build a small and very beautiful nest, delicately and neatly constructed; the framework consists of woven twigs and stems and moss, the cup being smoothly lined with cotton-grass down and feathers. Should the little birds be able to obtain a supply of swan's down, she will make with it

a most beautiful fringe to the edge of the cup, the tips of the delicate white feathers only showing, and curving gracefully inwards.

The Hedge Sparrow, which is no relative of the vulgar and assertive House Sparrow at all, and the very opposite in both manners and habits, displays considerable ingenuity in the construction of its nest. The site selected is generally well concealed in the heart of a dense hedgerow or thicket, or in the midst of a dense growth of ivy. The nest is a fairly substantial structure, the bird frequently using elm twigs as an outside stiffening to the moss and twigs which form the main material, while the inside is lined with wool and hair, forming a soft warm bed for the lovely deep-blue eggs.

As we tramp across a stretch of heather-clad moor, a little bird may rise almost at our feet and flutter away a few yards, only to sink down again amongst the coarse grasses and ling, as if exhausted. Should we pursue her, she will again rise, and flutter on a few yards as if on injured wing, giving vent to a few plaintive notes. This little brown bird is the Titlark or Meadow Pipit, and she is not injured at all, but only seeking to lead us away from her nest.

It is a clever device on her part, and one which we may well hope to be always successful. The dainty little nest is a very frail affair, often resting in a slight depression on the ground among the heather and grass tussocks, and is made of dry grass-stems delicately woven together, with a lining of finer grasses.

The little Willow Wren, whose sweet song the famous American naturalist Burroughs considered one of the most beautiful melodies produced by any British bird, is not really any near relation to the true Wren. Its sweet, quiet song may be heard among the alders, and the tangled growth fringing any wandering stream, from about the end of March until the summer has far advanced. The graceful little bird builds a beautiful domed nest, with a large entrance hole at the side, using dried grass, dead leaves, and moss in its construction, and lining it with a soft thick bedding of feathers. The nest is generally built very close to, if not actually touching the ground, and is well concealed from view, so that it is generally rather a difficult matter to watch the actual building in progress.

The true Wren is by no means a shy bird,

and is always delightful and interesting to watch, as it pops about a tangle of undergrowth eagerly seeking for the insects upon which it feeds. Though so small, it is a courageous little bird, and will follow a poaching cat or a stoat along the hedgerow, giving vent to an unceasing flow of abuse, and most effectually drawing the attention of all other creatures to the presence of the marauder. For so small a bird, it has a most surprisingly loud, shrill song. Very varied sites are selected by the Wren for its nest, such as among a dense growth of ivy, or an old wall, or tree, in a hole in a thatched roof, under the shelter of the overhanging turf and roots near the top of a steep bank, or in a tangle of brambles and dead bracken fern in an open woodland glade. The nest is round or oval in shape, with the entrance hole in the side, moss and dead leaves being used chiefly in its construction; and feathers, fern, moss and pieces of dry leaves felted together to form a soft lining. When built among brambles and bracken, the nest is by no means readily detected, as the bird will utilize the dead stems of the ferns as a natural framework, weaving

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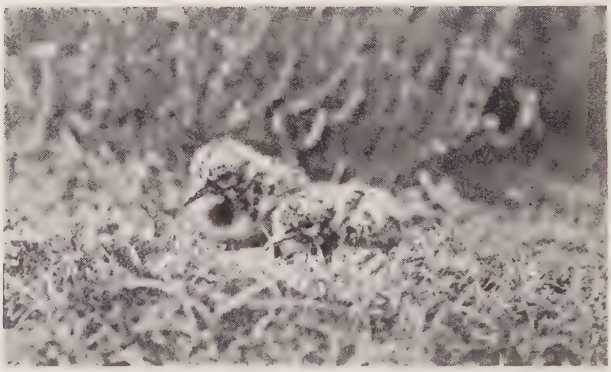

2

1. A YOUNG WRYNECK AT ENTRANCE TO NEST-HOLE
2. BABY LAPWINGS NESTLING AMONG THE MOSS AND HEATHER

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the branches together most cleverly. The Wren has a peculiar, and, I believe, still imperfectly understood, habit of partially building several nests before constructing the one intended for the reception and incubation of the eggs. They are not ordinary nests that have been abandoned half-way through their construction, but are considered by some authorities to be nest-like structures built for the purpose of courtship, like the decorated bowers and runs of the Australian Bower-birds. Whether this is their true function I cannot say from personal observation, but certainly these "cock-nests," as they are called by country folk, are very rarely used as the foundation of a true nest.

An interesting bird that does not build a nest, but contents itself with a soft and often scanty layer of rotten wood at the bottom of a hole in a tree, is the Wryneck. The bird has many local names, such as Snake-bird, Cuckoo's Mate, Rinding-bird, all of which refer to some peculiarity. Its most general name of Wryneck is descriptive of the odd contortions of its flexible neck; while that of Snake-bird comes from the peculiar hissing

sound the bird makes when alarmed. Cuckoo's Mate refers to its arrival about the same time as the Cuckoo, and the name of Rinding-bird refers to its appearance at the season of the Spring when the oak-bark stripping, or rinding as it is called, is in progress. One Springtime in the New Forest, I watched, and became on quite friendly terms with a Wryneck, who had taken up her quarters in a hollow in the trunk of an old thorn-tree. When I first observed her, she had not long selected her nesting site, for there was only one pure white, glossy egg at the bottom of the hole. I remember I watched her with considerable solicitude, for that pest of the forest, the professional collector was abroad, and had rifled many nests that I and my wife had watched the birds building, and we were fearful that he would find this Wryneck and rob her of her treasures. Day by day we visited the old thorn-tree, and the little bird became quite accustomed to our presence, and would answer to our call without leaving the hole in the trunk of the tree, and we would sit in the heather and bracken and watch her come forth for a hasty meal, and to stretch her cramped limbs. Once or twice she

HIS FIRST PEEP AT THE GREAT OUTSIDE WORLD. YOUNG BLUE-TIT ABOUT TO LEAVE NESTING-BOX

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did not answer to our call, and then when we peeped down the hollow entrance to her chamber, fearing the nest had been rifled, she suddenly made a most extraordinary explosive sound and flew out on to a bough, returning, however, in a few minutes to her eggs when she found that only her friends were present. This noise invariably made us start back, and I can quite imagine that it would startle and probably frighten away any furred or feathered foes. She brought up her brood successfully, and we had the delight of watching the young birds in the last days before their flight, appearing at, and climbing on, the side of the entrance of the hollow, anxiously on the look-out for the return of Mother Wryneck with insect dainties for them.

If a nesting-box containing a layer of crumbled dead wood be attached to the trunk of a tree in some quiet corner of a bird-frequented garden, the Wryneck may be induced to utilize it. Every garden that has shady banks and trees should be a sanctuary for the birds, and no effort should be spared to encourage them to build therein, for the good they will do in holding the various insect

pests in check, and the delight their pretty ways and joyous songs will give us, far outweighs the small toll from among the fruit-trees that some may take. Indeed, the House Sparrow is the only unwelcome visitor, for he drives away the shyer birds, and is wantonly destructive in his habits. In the Autumn a larch pole should be set firmly in the ground in view of the windows of the house, and to its sides, well up out of reach of the cats, an encircling board to form a table should be attached. Above the table should be nailed a cross-piece from which a cocoa-nut with its ends sawn off, and a lump of fat or an old beef-bone can be suspended for the Tits. The table should be supplied with water, crumbs, mixed bird-seed, and in hard weather a little finely-chopped raw meat; and if this table is kept well served throughout the Spring as well as during the winter, the birds will come regularly to feed and drink, and will leave the seed-beds alone. Then, as the season advances, we shall find that the nesting-boxes, if properly constructed, and attached to suitable trees and the sides of outhouses, will be certain of tenants. It is a most charming and

interesting sight to watch a pair of Blue Tits in the Spring busily engaged in lining one of these boxes with moss, down and wool; and later on to see the little parents working so hard, flying backwards and forwards all day long, with tiny caterpillars, green-fly, and other insects with which to feed their young. And then finally comes the all-important day when the youngsters quit the nest. There is such excitement, such flying back and forth of parent birds, such twittering and excited struggling of young birds, half eager, half afraid to leave the old home and face the great leafy world. The strongest youngster appears at the entrance hole, and half thrusts its body out, giving vent to shrill, excited cries. Then suddenly it is pulled back by its equally excited brothers and sisters, and disappears into the depths of the nesting-box, and another little excited fledgling appears at the entrance, only in turn to disappear and make room for another nestling anxious to look at the world outside. At last they grow bolder, encouraged by the parent birds who feed them all the time, and so one by one the wee things spread their wings and take their first flight abroad, and

the old nest-box grows silent and empty. We who have watched, sympathized, and delighted in the loving labours of the parent birds, and the growth of their large and happy family, feel a little lonesome and forlorn now they have gone, but we know that if all is well they will come back to us and to their food-table when chill Autumn makes provisions grow scanty in the fields, and that next Spring will find the old nesting-box once more tenanted. Good-bye, wee joyous birds, would that we could teach your many selfish, cruel and ignorant human foes to love and cherish you, and to take to heart those beautiful lines of Alfred Tennyson, who loved you all so dearly—

> "Hold thou, my friend, no lesser life in scorn,
> All Nature is the womb whence Man is born."

CHAPTER IV

BY POND AND STREAM IN SPRINGTIME

"The kingcup fills her footprints, and above
Broaden the glowing isles of vernal blue."

Down in the lush water-meadows the golden chalices of the Kingcups are opening in the sun, making a gay carpet for the footsteps of Persephone. Ever and anon the soft west wind, fragrant with the scent of the willows that fringe the mill-pond, bring to our ears the hum of Bees, singing at their work among the sweet-scented, golden and grey-green willow catkins that stand out erect upon the branches. From time to time the sound of a distant splash and the harsh call of the Coots comes from amidst the reeds and rushes, where the birds are feeding or prospecting for likely nesting sites. Over all shines the soft splendour of the Spring sunshine, while high up, a mere quivering speck in the deep-blue sky, a lark sends down a flood of joyous melody—

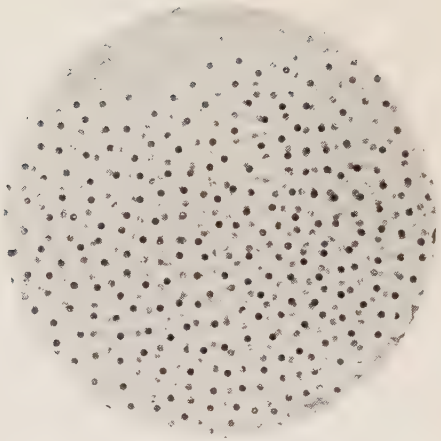
"Singing, thou scalest heaven upon thy wings,
Thou liftest a glad heart into the skies;
He maketh his own sunrise while he sings,
And turns the dusty earth to Paradise."

All Nature's children are stirring, awakening from their long winter sleep, and

"Light again, leaf again, life again, love again,"

is the order of the day. Even the frogs and toads, generally impassive enough, have felt Spring's call, and are congregating along the banks of the pond and the stream that feeds it, to mate and spawn. If we approach cautiously the edge of the bank where the water is shallow, we may see them squatting up to their eyes and nose-tips in water, giving vent from time to time to excited, amorous croakings, which grow louder as evening draws on. Soon great masses of frog-spawn and the smaller, more ribband-like spawn of the toads will be seen in every shallow pool, and the companies of frogs and toads will disperse into the moist meadows and shady banks, for the act of spawning once accomplished, these creatures take no further thought for their offspring.

The life-history of the frog is really very



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1. FROG SPAWN. 2. TADPOLES AT DIFFERENT STAGES OF GROWTH
3. TADPOLES WITH DEVELOPING LEGS

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wonderful, and with the exercise of but a little care and patience it is possible for anybody to watch it, step by step, from the spawn to the perfect frog. If we have not a proper aquarium at our disposal, a fairly large inverted bell or propagating glass, fixed to a firm base will answer admirably; while with care in keeping the water fresh, a large glass pickle- or jam-jar may be pressed into service. Whatever the receptacle may be, it should have one or two water-plants growing in it, or a good spray of Pond Weed (*Anacharis*, to help oxygenate the water, and for the tadpoles to nibble at. Unless the water is kept well oxygenated, either by the help of growing water-plants, or by daily renewal, pouring the fresh water in a thin stream from a height into the aquarium, so that it is well aerated, the mortality among the tadpoles will be great. For the same reasons do not place too large a mass of spawn or too many tadpoles in one receptacle.

When we examine a mass of frog-spawn in a glass jar or aquarium, we shall see that it consists of innumerable transparent spheres of a jelly-like substance, each sphere

having a small opaque, globular body in its centre, the future tadpole, darker on one side than the other. With the aid of a good magnifying glass we may be able to make out the appearance of a furrow which forms across both the dark and light halves of the opaque inner sphere, dividing it equally. This furrow is soon crossed by another, formed at right-angles to it. We may say that these two furrows cross, and pass from pole to pole of the tiny sphere. Then a third furrow is formed, passing round the equator of the tiny sphere, but nearer the dark portion than the white part, and this process of division or segmentation as it is called, continues until the little sphere or embryo consists of a mass of cells, and looks rather like a tiny mulberry. Soon after this it begins to elongate, and the head and tail of the future tadpole begin to appear, and the external breathing gills to develop. The tiny creature still lies in the centre of the transparent envelope in a curved position, but now shows signs of animation, jerking about inside the envelope until at last it makes its escape into the surrounding water. The external breathing gills or branchiæ, after

attaining their maximum development, gradually decrease in size, until they are withdrawn in what is called the branchial cavity and concealed from view by a little fold of skin. They are now supplied with water drawn into the mouth by the nostrils, and from the water with which they are thus constantly bathed they extract the oxygen ere it is expelled through the gill-slits. Eventually the branchiæ are absorbed, their place being taken by true lungs, and the animal respires directly from the atmosphere. The limbs, at first scarcely perceptible, are gradually developed, passing through a rudimentary stage beneath the skin ere they emerge in their definite shape. The hind legs appear first, and are used to assist the strong and comparatively large tail in propelling the tadpole through the water. The development of the front legs appears to be a critical period in the life of the tadpole when bred in captivity, and may possibly be so under natural conditions. I have noticed nearly every year, when rearing tadpoles in the aquarium, that a number die on reaching this stage of their development. Indeed, I well remember one Spring when the mortality at this stage was so

great that at last only one little tadpole remained, and that a town-born servant who was with us at the time, and quite deeply interested in this her first insight into the wonders of Nature, burst in upon us at the breakfast table one morning with the tragic announcement, "Please, sir, the taddy has just died a-cutting of his front legs!" Those tadpoles which come safely through this period in the aquarium, generally successfully complete the rest of their transformation. The tail of the tadpole does not drop off, but as the legs grow, it gradually diminishes by absorption, steadily dwindling in size until it totally disappears, and the perfect baby frog is ready to make its first excursion on land.

The Newts at this season of the year display great activity, swimming about in the pools, and the sexes are readily distinguished, the serrated crest along the back of the male being fully developed, which, coupled with the bright orange colour of his waistcoat, makes him a very handsome fellow indeed. In the more remote parts of the country, in the west, and in the fen-lands, many quaint ideas concerning these pretty and absolutely harmless creatures

still linger. To their presence in the drinking-pond is frequently attributed the sudden outbreak of some mysterious disease amongst the cattle. Cows are said to yield less morning milk, owing to the Newts having crawled about their udders during the night, and also that they will produce rheumatism by creeping over the limbs of cattle, horses, and even human beings. Needless to say, these base charges against the character of the Newt are utterly without foundation of any kind. The female Newt is destitute of any crest, and is a very interesting little creature to watch when she is engaged in the important business of depositing her eggs. She may then be seen swimming actively from one water-plant to another, gravely inspecting each in turn, and considering its suitability for the reception of her eggs. Having selected the plant, she then proceeds to lay her eggs, singly or in pairs, folding the leaves around them so that they may be well screened from the observation of the many other aquatic animals who would eagerly devour them. The eggs are not all deposited at once, but at intervals, the process of their deposition amongst the leaves of the aquatic

plants covering three weeks to a month. The resulting tadpoles are far more shapely than those of the frog or toad, and are readily recognized by their plume-like, external gills.

The pugnacious little male Sticklebacks are just now resplendent in all the glory of their prismatic hues, for the Springtime is also their season of courtship, and we may see them chasing and fighting with each other in the shallows of the stream. They are very plucky little fish, and are ready to do battle with all comers, as well as thoroughly enjoying a fight amongst themselves. They are most interesting and graceful little creatures, and indulge in the curious and unfishlike habit of nest-building; and, as they take kindly to the confinement of a fair-sized and well-kept aquarium, it is possible to watch them all the year round at their work or play, the nest-building and rearing of the young being a most interesting sight to witness.

The little male Stickleback having selected a suitable site on the bottom of a shallow in the stream (or on the floor of the aquarium), first forms the floor of the nest, and then the sides and the top, leaving an opening at each

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1. THE FROGS ASSEMBLE ON THE BANKS OF THE POND
2. THE STICKLEBACK ON GUARD

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end (sometimes only at one end), the whole being composed of the delicate rootlets and slenderest stems of the water-plants, cemented together with a natural secretion. This task accomplished, the little fish goes off to seek his lady-love, and presently returns with her to the neighbourhood of the nest. Then a great deal of fussing and coaxing takes place, for at first the little female is shy, or does not approve the appearance of the nest, and absolutely declines to enter it. The little male grows tremendously excited at her reluctance to comply with his wishes, hovering over and half entering the nest, as if to show the way in, and then returning to her and swimming round her in the most coaxing way imaginable, and gradually edging her towards the nest until at last he persuades her to enter, or drives her in. She does not remain within the nest for very long, however, for directly she has deposited her eggs she emerges and at once departs to enjoy herself, leaving the little male to mount guard over the nest and its precious contents. If his first wife has not deposited what he considers to be an adequate number of eggs, the little Stickleback will again go a-courting, and

bring a second wife to add her eggs to those already in the nest. When she in turn has been coaxed or driven into the nest, deposited her spawn, and departed on pleasure bent, the little male takes up his duties and watches faithfully over the nest until the young are hatched; dashing upon, and driving away from the vicinity of the nest, all unwelcome visitors. From time to time the little Stickleback will hover over the opening in the nest, vibrating his little fins as rapidly as he can, so as to produce a current of water through the nest to aerate the spawn within. Even when the young fry are safely hatched, the gallant little father Stickleback displays the greatest anxiety for their welfare, hovering near them, and fighting or driving away all other creatures that dare to approach too near his precious offspring; for he knows only too well that a sinister object attaches to their desire for closer acquaintanceship with his babies, for whom they have literally a devouring affection. And I am sorry to say that he has to wage war even against his own species, who are only too ready to gobble up his offspring, should they have the chance. One Spring I well remember wit-

nessing such a cannibalistic feast take place in one of my large aquaria. One of the male Sticklebacks had built his nest so near to the glass front that I could watch with ease all that he was doing. There happened to be several caddis-worms dwelling in the tank at the same time, and these caused my little friend constant trouble, for one or other of them would from time to time suddenly blunder on to the nest. The little Stickleback would pounce upon the offending caddis-worm, seize it, shake it like a fox-terrier shaking a rat, and then swim off with it in his jaws, and deposit the astonished larva at a distance from the nest. But his triumph was generally short-lived, for did he turn his back on the nest for a few minutes to catch a hasty meal, or to drive away some other foe, so surely would another caddis-larva seize the opportunity to wander on to the nest, where its legs would get entangled in the network of slender stems and rootlets. The struggles which ensued in pulling the offender off, tried not only the patience of the little Stickleback, but also the structure of the nest sorely, so that the latter began to look very ragged and untidy, its ruinous appearance

evidently causing the gallant little defender considerable anxiety, for he tried again and again to patch it up. At last, however, in the course of a prolonged and heroic struggle with a particularly obstinate, intruding caddis-larva, the top of the nest was completely torn off, and the precious spawn scattered. In an instant the other Sticklebacks gathered to the feast, and although the courageous little father dashed amongst them and fought right and left, they quickly devoured all the scattered spawn.

The caddis-larvæ, or caddis-worms as they are often called, are the larvæ of the pretty Caddis Flies, and are the "old clo'" insects of ponds and streams, where they are to be found in great abundance during the Spring and early Summer, crawling in an ungainly manner over the bottom. Only their heads and the segments bearing the three pairs of legs are horny, the rest of the body being soft. It is to protect and hide the plump, soft body from the hungry eyes of their many foes, that these larvæ have developed the curious habit of collecting pieces of dead leaves, twigs, tiny shells, fragments of flint and other unconsidered trifles,

and, with the help of a silky secretion, forming them into a garment or case. When alarmed, they withdraw partially or wholly within the case so formed, and remain absolutely motionless until the danger has passed. I shrewdly suspect that the caddis-worms who caused my little Stickleback the loss of his nest and eggs were really attracted by the rootlets and delicate stems used in the construction of the nest, and were filled with desire to appropriate such suitable material for their own wardrobe.

As we rest on the bank of the stream watching the Sticklebacks at play in the shallows, our eyes catch for a second a flash of glittering blue, as with a thin, shrill, piping cry the Kingfisher passes swiftly up-stream to his favourite haunt. Long persecution has made it a shy and wary bird, but I am glad to say, thanks to the Acts for the protection of our useful and rarer birds, the Kingfisher, which at one time seemed to be threatened by extinction, has in parts of the country of late increased in number, and given an added interest and beauty to our streams. If we know his haunts, and go quietly, we may steal near enough to watch him where he sits, perched on a bough that overhangs

the stream, his bright eyes alert and watchful. Suddenly he swoops downward, cleaving the water with a resounding smack, and returns as quickly to his favourite bough with his silvery capture, which he holds for a moment in his beak, ere shaking it right way up and swallowing it. The Kingfisher makes a lovely picture, perched there on the old moss-clad bough that stretches far out over the quiet pool; the soft Spring sunshine glinting on the metallic sheen of his lustrous plumage, and lighting up the green and gold of the Lesser Celandine and Primroses that clothe the banks, so that the whole presents such a scene of sweet charm and natural beauty as will remain a lasting memory. It is with a feeling of regret that we see him presently flit gently and swiftly out of sight.

A mile above the Kingfisher's pool, the stream wanders through a stretch of wild bog-land, the home of innumerable beautiful and interesting plants, insects and animals, and at this season of the year the favourite haunt of the Lapwings, or Plovers; for thanks to the soft and treacherous nature of the ground, they are fairly safe from molestation, and can nest and

THE HAUNT OF THE LAPWING

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rear their young in peace. It is a sad pity that these pretty, graceful, and most useful birds, should be so ruthlessly persecuted every Spring and robbed of their eggs; for the farmer has few more valuable friends than the Lapwings who roam his fields and pastures, seeking out and devouring the hordes of wire-worms, leather-jackets and other ground insects, which, if left unchecked, would utterly destroy his crops. Yet each Spring sees this same senseless sacrifice of Plovers' eggs to appease the depraved appetite of the gourmet, with the inevitable result that in many districts the Lapwings, or Plovers, are steadily decreasing in number.

But to return to our stream, which winds its way through the bog-land, sometimes quite lost to view amidst the growth of rushes, alders and fragrant aromatic Bog Myrtle, then reappearing where the ground gently slopes to the west, amid cresses and forget-me-nots, to

> "Chatter over stony ways,
> In little sharps and trebles."

We must go cautiously, following as far as possible the tracks of the half-wild forest ponies, to avoid the dangers of the quaking

bogs, where the ground shakes beneath the tread and a false step may engulf us in the morass. It is wonderful with what intelligence the forest ponies cross these bog-lands, twisting and turning to right and left, as if they know every inch of the treacherous ground, so that they rarely sink over their fetlocks in the soft spongy soil. At our approach the Lapwings rise from amidst the reeds and sphagnum moss, and make wide circles round our heads, uttering their musical plaintive cry—pee-wit, pee-e-wit, pee-e-wit. So close do they fly over our heads, that we can hear the curious creaking sound of their wing-feathers as they beat the air. Early in the Spring it is the male bird who rises first, and by his swooping and cries strives to lead us away; the hen bird quietly slipping off the saucer-like hollow scooped in the ground and lined with a few bents, which serves as the nest, and stealing through the grasses for a little distance ere she rises. Later, when the young are hatched, both the parent birds will rise at once (unless the hen is brooding her chicks, when she will endeavour to steal away unobserved, as when leaving the nest), and giving vent to their

plaintive cry, go through all sorts of quaint antics on the wing, to try and draw our attention away from the spot where the chicks are crouching motionless, pressed close to the ground. The little Lapwing chicks are able to run as soon as their downy covering has dried, after breaking out of the shell, and are the most delightful little bird babies imaginable. The soft grey mottling of their down makes them very inconspicuous among the dead heather and mosses, so that when they are alarmed, and crouch down absolutely motionless in the moss, it is almost impossible to find them; and so long as the old birds are wheeling and calling overhead, they will lie close to the ground, so that we are actually in danger of walking over them in our search. Our best chance of obtaining a sight of them is to draw away from the immediate vicinity of the spot where we suspect that the chicks lie hidden, and to find some vantage point, if possible, overlooking it, where we can lie screened amongst the bushes and quietly watch through our prism-glasses. For some time after we have taken up our position, and particularly if we have blundered nearly on to the spot where

the chicks lie hid, the parent birds will probably continue to circle round and call to one another. Then they will separate and settle some little distance away, perhaps higher up the bog, and run in little short spurts backwards and forwards, calling across the intervening space to each other. In this way the hen bird will gradually slip back towards her chicks, running from tussock to tussock, and lifting her head above the grasses to peer cautiously in all directions. Should she now catch sight of us, or her attention be attracted by any movement on our part, she will be up and off again, and then we may have to wait for an hour or longer, with the gnats and midges biting and tickling and making life an itching misery, ere she will again summon sufficient courage to approach her young. If, however, she is not alarmed, she will continue her circuitous progress, keeping up a running conversation with her husband, who is also moving about and now and then rising on his graceful wings to take a circling sweep to see that the coast is clear. At last she comes to a little mossy space, and giving a contented, half-inquiring cry, pauses. It is answered by an

assuring call from her husband, and for a few minutes she stands preening her feathers, her beautiful white breast gleaming in the sun, ere she settles herself comfortably on the moss. Then she gives a soft call, answered by the shrill, piping trill of the young chicks, who seem literally to rise up out of the ground near by and run to their mother. For a few minutes they play round her, and then one by one, with sleepy little twitterings, steal beneath the pure white feathers of her breast to rest. The mother bird gives vent to a few gentle notes of joy, and for a while no sound save the soft tinkle of the stream and the low sighing of the wind through the reeds disturbs the perfect peace and deep silence of the bog.

PART II

SUMMER THE PAGEANT OF NATURE

"'Tis time to sing! Now is the pride of youth
Pluming the woods, and the first rose appears,
And summer from the chambers of the south
Is coming up to wipe away all tears!"

CHAPTER V

THE ROMANCE OF THE LEAF

"Lo! in the middle of the wood,
The folded leaf is woo'd from out the bud
With winds upon the branch, and there
Grows green and broad, and takes no care,
Sun-steep'd at noon, and in the moon
Nightly dew-fed."

SUMMER has spread her green mantle over hillside and valley, so that it is now indeed a leafy world through which we wander, filled with new beauties and new wonders, all the pomp and pageantry of Nature. As we wander down the hedgerows, across the meadows, or through the woods, we cannot help noticing the luxuriant growth of plant life on every side, the varying shades of green, and the many different shapes of the leaves. Indeed, as Ruskin has written, "the leaves of the herbage at our feet take all kinds of strange shapes, as if to invite us to examine them. Star-shaped, heart-shaped, spear-shaped, arrow-shaped, fretted,

fringed, cleft, furrowed, serrated, sinuated, in whorls, in tufts, in spires, in wreaths, endlessly expressive, descriptive, fantastic, never the same from foot of stalk to blossom, they seem perpetually to tempt our watchfulness and take delight in outstripping our wonder."

At first, as our eyes rove casually over this leafy world, the varied forms seem to be jumbled together in disorderly array, but when we come to look a little more closely, we find that this is by no means the case, and that certain types of leaves are peculiar to certain situations. Also we shall find that the individual leaves on a plant or tree are so arranged that they do not get in each other's way, or entirely overshadow each other. Gradually from such observation during our walks we shall also come to realize that the leaves of many plants and trees are so arranged on their branches as to form a kind of leaf-mosaic, and this we are able to see best when we look down upon them from above; in fact, just as the sun looks at them. We have all probably at one time or another admired and wondered at a luxuriant growth of ivy clothing the walls of some old castle gateway or ancient ruin in a

dense and leafy mantle. Now if we look a little closer, we shall find something even more wonderful about this ivy, and that is that scarcely one of its many thousand leaves so completely overshadows another as to prevent any sunlight falling upon it, so that really the walls are covered by a leaf-mosaic. From under the shade of the ivy-mantled walls we pass to the lanes and fields again, and here we shall find endless examples of leaf-mosaics, many of them of extreme grace and beauty in their shape and outline. Notice particularly the beauty of the mosaic formed by the leaves of the Beech-trees, one of the most beautiful to be found in the woodland.

From looking for leaf-mosaics, it is only natural that we should begin to examine the shapes of the leaves themselves, and how they vary with the situations in which we find them growing. The first thing to strike us will probably be the tendency of plants growing in very crowded situations to have narrow or deeply-cleft leaves, which offer as little obstacle as possible to the free passage of air and sunlight; while plants growing in less crowded situations where they have plenty of elbow-

room, tend to grow broad, circular or oval-shaped leaves. Another point in connection with the leaves that we shall notice, is that they are lighter in colour on their under surface, the side that is turned away from the light. If we stand on the brow of a hill overlooking a wood on a sunny day, we shall see that whenever the breezes set the branches swaying, ripples of light play over the woodland, due to the under surfaces of the leaves being momentarily exposed by the movements of the branches.

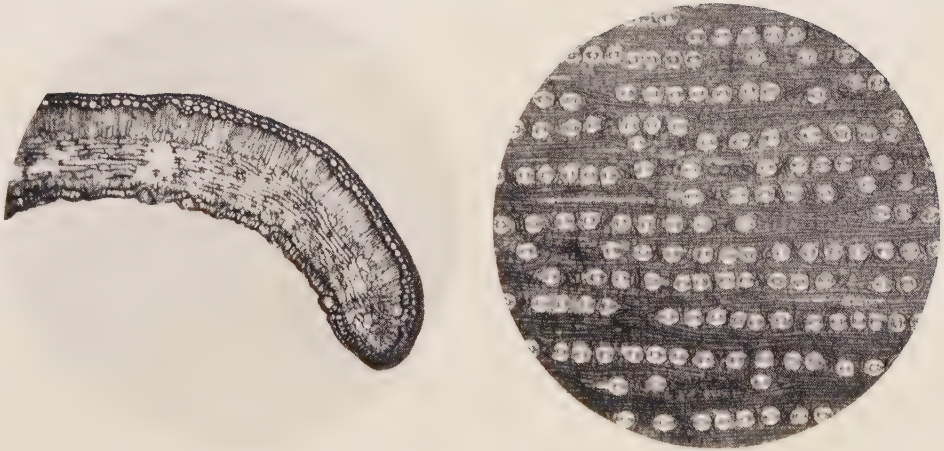
Now let us try to make out the true significance of all these characteristics of the leaves, and their relation to the plants and trees on which they grow.

All green plants draw their most important food supplies directly from the atmosphere. Now the great food substance of all the trees and green plants is carbon, and the whole of this food the trees and plants obtain from the air, chiefly through the agency of their leaves. Under the action of sunlight the plants obtain their supply of carbon from the carbonic acid gas, or, more correctly speaking, from the carbon dioxide as the chemists call it, which

exists in very small quantities in the air. The plants absorb the carbonic acid gas from the atmosphere, and, with the aid of the sunlight, decompose it, so that the oxygen is given back to the air, while the carbon is retained for the manufacture of various organic substances, such as starch, sugar, oil, etc. This work of decomposing or splitting up the carbon dioxide, which would need an expert chemist to accomplish as a laboratory experiment, is successfully and entirely performed by the minute green particles called chlorophyll granules, which give to the trees and plants their green colour, and which can only accomplish this work under the influence of light. Therefore these tiny microscopic chlorophyll bodies are of the greatest importance not only to the plant, but to all living things, for without the plants we could not exist, and they are absolutely dependent upon the green chlorophyll bodies to obtain their supply of carbon food from the air. This important work of the chlorophyll granules is called assimilation. Another important point which we must keep in mind is that the green colouring matter of plants can only be formed under the influence of light,

for although the particles of protoplasm which form the chlorophyll bodies become differentiated from the rest of the protoplasm in the cells of the tissues in plants grown in the dark, they remain almost colourless, a pale yellow, giving the plants a sickly, unhealthy, and unnatural appearance until exposed to the light, when they soon acquire their green hue.

Sunlight and air, therefore, are of the greatest importance to the trees and green plants, and we can now realize why they always grow towards the light. Let us, however, consider the leaves, which are the chief factors in keeping up the food supplies. Under the radiant energy derived from the sunlight, the leaf absorbs the carbonic acid gas from the air, liberating the oxygen, and using the carbon as the foundation for the manufacture of organic products, in which water from the roots, and, in certain cases, salts in solution drawn up in the water are employed. To fully realize the wonderful mechanism of the leaf, and how beautifully it is adapted to the functions it has to perform, we must examine closely its structure under the magnifying power of a microscope. We must make a very thin slice



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1. VERTICAL SECTION THROUGH A LEAF, SHOWING THE PALISADE CELLS, SPONGY TISSUE, STOMA, ETC. 2. ON THE UNDER SURFACE OF LEAVES ARE THE INNUMERABLE, MINUTE, LIP-LIKE OPENINGS CALLED STOMATA

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across the leaf, what is technically called a vertical section, for this purpose, and then we shall be able to see the different layers of cells in their positions in the leaf.

First we shall see that the upper surface of the leaf consists of a layer of cells, with thick corky walls, forming a colourless layer of epidermal (skin) tissue, rich in water—a layer of water-bags as it were, through which the sun shines, and some of its heat probably cut off. Immediately below this transparent layer of water-cells is a layer of closely-packed, elongated cells, which from their shape are called the palisade cells, filled with green chlorophyll granules, which take up the carbon, and proceed to manufacture with it starches, sugars and other complex products. Below the elongated palisade cells we shall see a layer of loose tissue extending to the lower epidermis of the leaf, forming a network of cells with wide meshes or intercellular spaces, called the spongy parenchyma, part of whose function it is to help in the evaporation of unnecessary or superfluous water, and so help to keep up the circulation of the sap. In the layer of cells immediately below the loose tissue of

the spongy parenchyma, and forming the skin, or epidermis, of the lower surface of the leaf, we shall be able to make out several openings, called the stomata. These stomata are very numerous, usually several hundred on every square inch of the leaf, and are practically restricted to the under surface, except in plants like Water-lilies and Duckweed, whose leaves float upon the water, where, of course, the stomata occur on the upper surface of the leaf; while on leaves which grow upright they are equally distributed on both sides. These stomata are the organs by which the gaseous interchange between the green parts of plants and the air is maintained. In the case of assimilation, the carbonic acid enters through the stomata into the air-chamber, or opening, we have seen in our vertical section, and is thence absorbed by the mesophyll-cells surrounding it, the walls of these cells being composed of a substance called cellulose, which does not hinder the passage of the gas. The carbonic acid, or carbon dioxide, thus absorbed is at once dissolved in the cell-sap, and it is this gas which is decomposed by the chlorophyll granules.

The mechanism of these stomata is very

interesting, and to observe them better we will examine a small portion of the under surface of a leaf with the aid of a microscope. We shall then see that each tiny opening, or air-chamber of the stoma, is bounded by two special cells of the epidermis, which remind us in shape of the lips of a human mouth, and are called the guard-cells. These guard-cells, unlike the ordinary cells of the epidermis, contain green chlorophyll granules, and are therefore able to form starch and grape-sugar, just as the cells composing the inner tissues of the leaves do. Thus, under the action of light, these chlorophyll grains of the guard-cells become active, forming new organic substances which pass into solution in the cell-sap, which, becoming gradually more concentrated, causes water to be absorbed by osmosis from the neighbouring cells, so that the guard-cells become distended and the stoma or aperture between them opened; while when the guard-cells contain less fluid, their walls, like lips, draw closer together over the tiny mouth or stoma. There is another very important function which the stomata have to perform, and that is the process of governing the amount of superfluous

moisture which the plant gives off, and which is called transpiration. Although a great deal of the water absorbed by the roots and passed on throughout the plant, is used in the process of growth, and the manufacture of organic substances, under normal circumstances there is always a superfluous amount during the Spring and Summer, which is exhaled through the stomata of the leaf. Some idea of the amount of moisture drawn out of the soil by the roots of a plant, and exhaled as water-vapour through the stomata of its leaves, has been gained by experiments carried out on an acre of cabbages. The cabbages were planted in rows eighteen inches apart, the plants being eighteen inches from each other, and it was estimated that when the plants were making growth, and both roots and leaves carrying on their functions, that more than ten tons' weight of water was exhaled by the fleshy leaves of the cabbages in the course of twelve hours. So long as there is an abundance of water in the tissues of the leaf, the guard-cells will remain swollen and open, but, as the water diminishes, they gradually close. Therefore, on dry days, when the plant or tree is losing a great deal of water to the air,

and the leaves in consequence begin to droop, the water-tension of the guard-cells is lessened, causing the stomata to close automatically, and retarding the excessive transpiration. With the coming of a welcome shower, there is an increase in the water-tension, and once more the tiny mouths are opened. The supply of water-vapour to be given off (transpired) by the stomata is drawn from the intercellular spaces in the leaf-tissue, into which it has been given out by what are called the mesophyll-cells; and more particularly by the cells of the spongy parenchyma. So long as transpiration is taking place, the mesophyll-cells are giving up water, and taking up fresh supplies from the water-conducting vessels of the vascular bundles which traverse the leaf, almost like irrigation channels in a field, and which in turn draw their supplies from the water absorbed from the soil by the root through its root-hairs. But simple as this brief outline may appear, the process of transpiration has still its unsolved problems. Of the passage of the sap and water up the tall stem, all that can at present be authoritatively stated is, that the first rising of the sap in the Spring is due to root-pressure; and its

more rapid movement as the season advances, after the leaves have expanded, is due to transpiration.

Should a sudden shower send us to shelter beneath the nobly spreading branches of a Horsechestnut-tree, we shall have an opportunity of observing another duty which the leaves perform, namely that of conducting the rain to the absorbent roots. In the case of the tree under which we are sheltering, the leaves slope outwards, and are so placed, tier upon tier, that the rain falling first upon the foliage of the topmost branches flows along the slanting surface to the apex of the leaves, and then drips on to the leaves of the next tier immediately beneath, whose surfaces are also inclined outward, and so travels on lower and lower, and at the same time farther and farther from the trunk, until at last it falls from the lowest and outermost leaves to the ground. When the shower is over, we shall find that while the spot where we stood at the foot of the tree is practically dry, there is a very wet zone encircling the tree at the point where its lowest branches extend to, probably far moister than the ground a few feet farther out in the open. If we were

to dig down into the soil at this spot, we should be at once convinced of the fact that the absorptive roots of the tree penetrate the earth to the region of this wet zone. While this tendency to lead the rain-water outward and away from the stem is characteristic of by far the greater number of our foliage trees, had we sheltered under a Yew, or a Plane-tree, we should soon have had proof that this is not always the case, for in both these trees the amount of water conducted directly down the trunk is quite considerable.

To be caught in a shower while rambling through the woods, now becomes an interesting instead of a vexing experience, for it affords us an opportunity of observing how the different trees and shrubs conduct the raindrops so that they shall reach the ground at the exact spot beneath which the absorbent roots lie. We shall find that in plants having deep tap-roots, like the Dandelion, for instance, there are always one or more main grooves on the upper surfaces of the leaves, and that the leaves have always such a form and position as will cause the rain as it falls upon them to flow towards the tap-root growing vertically beneath

the central stem. The Rhubarb, and the Beet-root, growing in the kitchen garden, are both good examples of plants which direct the rain towards their tap-roots; while the Foxgloves in the flower-border, or growing wild on the fringe of the wood, and whose contour is that of a graceful, slender pyramid, tend at the top of their stems to lead the raindrops in an outward direction; but the lower leaves as they catch the rain from those above, shelve inwards towards the stem for nearly three-quarters of their length, only the upper portion bending outwards and downwards, so that the bulk of the rain is after all conducted to the region of the tap-root.

The whole of the rain or dew deposited on a leaf, is by no means always at once conducted down to the roots, for the foliage leaves of a number of plants have become adapted to absorb directly a certain amount of rain and dew. Thus the lowest cells of the hairs which clothe the stem of the common Chickweed have been shown to act as absorbent cells, while the compound leaves of the Lady's Mantle will be found to retain rain and dew in the little hollow formed by their union with the leaf-

FOXGLOVES, SHOWING HOW THE LEAVES ARE ARRANGED UPON THE STEM SO AS NOT TO OVERSHADOW EACH OTHER, AND TO CONDUCT RAIN TO THE ROOTS

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stalk; and it is these brightly sparkling drops of moisture that have gained the plant another of its popular names, that of the Dew-cup. But probably the absorption of water is not so great in the Lady's Mantle as it is in the Chickweed, the former plant finding in these collections of water upon its leaves a protection from grazing animals, who will not touch the foliage so long as it sparkles with moisture. Other interesting examples for the retention and absorption of moisture we shall find in the grooved rachis of the Ash leaves, and the two tiny cups at the base of an Aspen leaf. The leaves of the Teasel form perfect cups, capable of holding quite a considerable amount of fluid, but here again we have a specialization of leaf-structure which is not intended purely for water-absorption, and I must therefore leave a detailed description of them for a subsequent chapter, when we shall have under consideration the adaptation of leaves for the capture of insects.

Continuing our examination of the leaves of different plants growing in various situations, we shall notice how they vary in texture and size, as well as in shape, and we shall find out

by close observation that many of these peculiarities have to do with the process of transpiration, producing means by which it may be regulated, for the maintenance of a free passage for the aqueous vapour, and also the prevention of excessive transpiration. It is obvious that should water be able to collect so as to form a layer over the cells in the immediate neighbourhood of the stomata, that serious injury would be caused to the plant, as not only would the process of transpiration be affected, but also the interchange of gases with the air. As the rain pours down, it is conducted off the upper surface of the leaves in various ways, as we have already seen, and we might very easily be led astray by casual observation, into the plausible idea that this is of course the reason why the stomata are in most plants collected on the under surface, and that their being so placed, is all-sufficient. But this delightfully simple explanation does not quite meet the case, for there are plants whose stomata are of necessity placed on the upper surface of the leaf—the Water-lilies, for example—and there is the mist and the dew to be taken into consideration. The common

expression that the dew is "falling" conveys the idea that the dew comes down from the skies like the rain, and that therefore only the upper surface of the leaf will be wetted. But I would ask you, when you may happen to stroll through the fields before breakfast on a dewy morning, to turn over one or two leaves and examine their under surface, when you will be quickly convinced that the lower surface is quite as heavily dew-besprinkled, as the upper surface of the leaf. Indeed, you will find that long after the dewdrops have disappeared from the upper surface of the leaf, and the sun is shining brightly, so that both transpiration and assimilation are going on, the underside is still studded with dewdrops, clearly showing the necessity for special devices to prevent water gaining access to the stomata. If we examine the Willows growing in the water-meadows, and fringing the mill-pond, on a dewy evening or early morning, we shall see that while there are plenty of dewdrops hanging from the under surface of the leaves, they do not actually wet this surface, and on the slightest movement of the leaves by the breeze they fall to the ground; and this we

shall find is due to a fine, closely adherent layer of wax. The rushes, irises and reed-like grasses growing in the same situation, favourable to the copious condensation of dew upon their leaves, protect their stomata in the same way by a coating of wax; while the Meadow-sweet, Coltsfoot, Butterbur and a whole host of other plants loving the moist water-meadows, protect their stomata by a thick felting of grey or white hairs. Hairs on the upper surface of leaves play an important part in protecting the epidermis from the scorching rays of the summer sun, and preventing excessive transpiration; while many leaves like the laurels and holly have the cell-walls of their upper epidermis immensely thickened as a protection against excessive transpiration.

All our observations have so far proved to us conclusively the immense importance of the leaf to the plant, and we know that if the plant or tree be entirely stripped of its foliage at a time when its store of reserve food is at a low ebb, or exhausted, it will inevitably perish. Therefore, it is obvious that the plant must do its best to protect or prevent the destruction of its leaves. That the plant has a host of foes

is equally obvious, for many animals live entirely upon a vegetable diet, devouring the foliage and green stems in the most wholesale fashion, so that unless the plant can set up some sort of defence, it must sooner or later become exterminated. It cannot attack its foes, neither can it run away from them, so the plant must needs devise some means which will teach its would-be foes to have a care how far they push their depredations. And here, again, we shall find the leaves play a most important part, some being armed with prickles or stout spines, stinging or irritating hairs, or containing poisons and corrosive fluids, or giving forth repellent odours. In some cases the plant rests content with protecting itself from its more aggressive foes, the poison contained in its leaves having no harmful effect upon its lesser enemies. The Deadly Nightshade, for instance, is quite an example of the old proverb that what is one man's meat is another man's poison, for while its leaves are very poisonous to grazing animals, the larvæ of a little beetle feed upon them without suffering any ill effects, though they rarely cause such havoc as to interfere with the growth of

the plant. Again, the Stinging Nettle, whose leaves are covered with glandular hairs, producing the most painful irritation when touched by the hand, or by the lips of a grazing animal, is yet the food-plant of the caterpillars of our beautiful Vanessa butterflies. The prickly, spiny foliage of the Gorse, the spiny clothing of the thistles, the sharp spines on the leaves of the lower branches of the Holly are all familiar examples of defence against the ravages of grazing animals; and, as we have seen in the case of the Lady's Mantle, plants also utilize accumulations of rain or dew, quite effectively as a means of protection; for grazing animals will reject, unless very hungry, any foliage in the pasture that is covered with dewdrops. Indeed, the more closely we examine them, the better we shall realize that the trees and plants have the most varied methods for protecting their foliage; methods in which the leaves themselves play a very important part.

Summer is the season when the leaves reach their full and luxuriant growth; it is the season of the year when we are brought into closest association with them, and can best observe

their varied shape and beauty of form, which we can only begin to properly appreciate when we know something of the very important duties which they have to perform. I have only been able to give here a brief outline of those duties, and have, as far as possible, purposely avoided technicalities, striving to show you what a wonderful thing the leaf really is, and to sketch the romance of the leaf in such terms as may encourage you to seek for yourself during your rambles through woodland and meadow, further insight into this most fascinating subject, and to fill in the fuller details of this outline sketch.

CHAPTER VI

A CHAPLET OF SUMMER FLOWERS

"They bring me tales of youth, and tones of love
And 'tis, and ever was, my wish and way,
To let all flowers live freely, and all die,
Whene'er their genius bids their souls depart,
Among their kindred in their native place."

WALTER SAVAGE LANDOR.

To me there is always something inexpressibly sad in the sight of wild flowers thoughtlessly gathered and tossed upon the dusty road to perish. They are so fair, so fragrant, and so wonderful in form and colour, that to pluck them and idly let them fall seems a most wanton, cruel act, a desecration of Nature. If we carry the story of Persephone in our hearts, we shall treasure them as they grow, remembering how she loved and cherished them, and how they burst forth in joyous radiance at her return from the dark shadows of the Under-World, and made a jewelled carpet for her feet. As Ruskin wrote in his *Præterita*—"A flower is to be watched as it

grows, in its association with the earth, the air, and the dew; its leaves are to be seen as they expand in sunshine; its colours, as they embroider the field or illumine the forest." That is, indeed, the only way to attain a true knowledge of the flowers, and a real appreciation not only of the grace and beauty of their form and colour, but also of the factors which have helped to produce them in such endless variety.

It is practically impossible to bring home wild flowers without their withering, unless they are carried in a collecting-tin with their stalks swathed in wet cotton-wool. If carried in the hand they will begin to droop within a few minutes from being gathered, and long before home can be reached they will be limp, faded, if not quite dead, presenting a most miserable appearance, their beauty gone for ever. Therefore, unless we have provided a suitable receptacle in which to carry them, let us try to restrain our first impulse to gather any flowers which attract our attention, and instead, stay a little time near them, that we may fully appreciate their beauty of form and colour.

There is another, and a far more important,

reason why we should refrain from gathering wild flowers, and more particularly the rarer ones, and that is because the plant is absolutely dependent upon them for the propagation and continuation of its species; for remember, the flowers are the seed-producing organs, and every flower that we pick means so many seeds the less, so many chances the less for fresh plants of that kind to spring into life next year. In the case of plants like the Snowdrop, Narcissus, Daffodil, which only have one flower, and of the Orchids whose flowers are all on one annual spike, to pick the flower or flower-spike is simply to help on the work of extermination which in many districts is sweeping away our rarer plants. Believe me, you will gain far more satisfaction, far more lasting pleasure, and a far deeper knowledge and interest in the flowers of the lanes, the meadows and the woodlands by watching and examining them as they grow, than by gathering them and bringing them home. If you would have something more tangible than the happy memory of those flowers which looked so beautiful growing in their natural home, why not try to sketch them? Your sketch may not

be a perfect one, it may be very crude indeed, but there will be good in it if it serves, when the winter winds howl in the chimney and the days are dark and drear, to recall the pleasant hours spent in the sunshine with the flowers; while the very act of attempting to draw the flowers will give you deeper insight into their varying forms and colour. Supposing, however, you have no gift for drawing, or the time or inclination to learn, that is no reason now-a-days why you should return from your country rambles without a permanent record of the flowers you have seen! The art of photography has become so greatly simplified that a very few hours of intelligent experimenting and reading will enable you to take, at any rate, a passable photograph. A camera should be as regular a companion as one's walking-stick, for there is no longer any need to burden oneself with bulky, heavy apparatus, except for very special work. There are now to be had light and dainty cameras, taking a small plate, which will slip into the pocket quite easily. Such a camera, called the "Sibyl," taking a plate $3\frac{1}{2} \times 2\frac{1}{2}$ inches in size, is my constant companion, and I can assure

you that the little prints, veritable sibylline leaves, recalling flowers, clouds, animals, insects, scenes and incidents of the passage of the seasons, are an unfailing source of pleasure during the long winter evenings.

And now let us go forth into the lanes and fields in search of the Summer flowers; not to gather them, but to consider and admire them as they grow, to become acquainted with them. First of the Summer flowers that we must try to visit, are the Orchids, for not only are they amongst the most beautiful and interesting of our native flowers, but most of them are in bloom almost before Spring has departed, so that if we delay our search until Summer has reached its zenith we shall be too late to see them in all their freshness and glory. We shall have to seek them in very varied situations, in the heart of the Beech-woods, in open meadows, on the softly-rolling chalk downs, in the marsh-land, on the heather-clad moorlands, and by the side of old winding bridle-paths; each situation being peculiarly favourable to certain species.

In all the Orchids the flower is extremely complex in its structure, and while some pre-

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1. THE SPOTTED ORCHIS. 2. FLOWER OF EARLY ORCHIS SHOWING THE PEAR-SHAPED POLLEN MASSES. 3. THE REMARKABLE FLOWERS OF THE SPIDER ORCHIS

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sent the most singular appearance, others are most exquisite in shape and colour. The different parts of the flower of an Orchid are rather difficult to make out at first, but if you will carefully read the following description, which I quote from Charles Darwin's most deeply-interesting book on *The Fertilization of Orchids*, I think you will be better able to understand the significance of these highly-complex and specialized flowers. "In all common Orchids there is only one well-developed stamen, which is confluent with the pistils, and they form together the column. The anther is divided into two cells, which are very distinct in most Orchids, so much so as to appear in some species like two separate anthers. In most Orchids the pollen grains cohere in masses, which are often supported by a very curious appendage called the caudicle. The pollen masses, with their caudicles and other appendages are called the pollinia. Orchids properly have three pistils or female organs, united together, the upper and anterior surfaces of two of which form the two stigmas. But the two are often completely confluent, so as to appear as one. The upper stigma is modi-

fied into an extraordinary organ called the rostellum, which in many Orchids presents no resemblance to a true stigma. When mature, it either includes or is altogether formed of viscid matter. In many species the pollen masses are firmly attached to a portion of the exterior membrane, which, when insects visit the flowers, is removed, together with the pollen masses. This removable portion consists in most British Orchids merely of a small piece of membrane, with a layer or ball of viscid matter underneath—the viscid disc. Lastly, the three outer divisions of the flower are called sepals, and form the calyx; but, instead of being green, as in most common flowers, they are generally coloured, like the three inner divisions or petals of the flower. In almost all the species one of the petals, which is properly the upper one, is larger than the others and stands on the lower side of the flower, where it offers a landing-place for insects, having been carried round by the twisting of the ovarium. It is called the lower lip or labellum, and often assumes most singular shapes. It secretes nectar for the sake of attracting insects, and is often produced into a

spur-like nectary." In the photograph of a single flower of the Early Orchid, the two pear-shaped pollinia can be seen, immediately in front of the entrance to the spur, and above the stigma; and also the broad lower lip or labellum upon which the insect alights when visiting the flower.

Now let us go forth for a ramble in search of some of the Orchids, that we may the better understand the special modifications of these flowers. The Early Orchid (*O. mascula*) we shall find growing in a moist, shady corner of the meadow, or a similar situation along the fringe of the wood. The Spotted Orchid (*O. maculata*) we must seek in rather more open situations, on the edge of the moorland and heather-clad commons, open woods and pastures. Both flower early in the Summer, and are similar in the action of their organs when visited by a Humble Bee. Having found one of these pretty Orchids, let us sit down near it, so that we can examine its flowers, and watch what happens when the Humble Bees visit them. When the Humble Bee arrives we shall see that it lands on the labellum and at once pushes its head into the chamber at the

back of which lies the stigma, in order to reach with its proboscis the end of the spur or nectary. Now the pouch-formed rostellum projects into the opening of the nectary in such a way that it is almost impossible for the Humble Bee to push its proboscis into it without the rostellum being touched, its exterior membrane ruptured, and the viscid discs at the base of the pollinia exposed and brought into contact with the insect's forehead as it is thrust into the opening of the nectary. Such is the peculiar nature of these discs, that the moment they are touched they firmly stick to the head of the bee; and as the viscid matter with which they are coated dries in a very few seconds, they quickly become cemented to the insect's head. The result is that when the Humble Bee withdraws its head, one or both pollinia will be withdrawn, firmly cemented to the head of the bee, from which they project in a more or less erect position like a pair of horns. If the pollinia remained in this position, when the insect visited another flower, they would be simply pushed against the pollinia of that flower and no purpose served. However, the minute discs of membrane to which the

caudicles adhere have a remarkable power of contraction, causing the pollinia to sweep through an angle of about ninety degrees towards the apex of the insect's proboscis. This movement only takes about thirty seconds to complete, practically just sufficient time for the bee to fly from one plant to another, so that when the insect alights again upon the labellum of a fresh flower the pollinia have assumed such a position that, as the insect thrusts forward its head into the chamber of the nectary, they will be brought against the sticky, receptive surface of the stigma. Although the surface of the stigma is very sticky, yet it is not so viscid as to entirely pull the whole pollinia off the bee's head, but is just sufficiently so to break the delicate threads by which the packets of pollen grains are tied together, and leave some of them attached to the stigma. The result is that the pollinia attached to the Humble Bee's head can be applied again and again to the stigmas of the Orchid flowers visited by the bee, and will leave a sufficient portion of pollen upon each, so that they will all be fertilized.

The handsome and interesting Pyramidal

Orchid we must seek on rather dry banks, along the lanes and fields in a limestone district, during June, July and August, when it is in flower. It is one of our native Orchids which we should make a point of trying to see growing in its natural environment, for Darwin considered it one of the most highly organized of the British Orchids. The parts of the flower differ in their relative positions a good deal from those of the Early Orchid we have just examined. It has two quite distinct rounded stigmatic surfaces, one on each side of the pouch-shaped rostellum. The rostellum overhangs the nectary in such a way as to partially close its orifice, and is hollowed out on the under-side in the middle, and filled with fluid. The viscid disc is single and saddle-shaped, bearing on its flat top, or the seat of the saddle, the two caudicles of the pollinia, and is on its under surface lined with a layer of a very adhesive substance which is formed within the rostellum. The labellum has two curious ridges, which slope inwards and down to the minute and partially-obstructed opening of the nectary, and serve as guides to the slender, flexible proboscis of the moths which visit the

flower. Very shortly after the flower has opened, the rostellum becomes symmetrically ruptured, so that the lip formed by the lower and bilobed portion of its exterior membrane, which projects into the mouth of the nectary, is depressed on receiving the slightest touch. When a moth settles on the labellum, and pushes its long slender proboscis along the guiding ridges, the proboscis, as it passes into the nectary, can hardly fail to touch and depress the lip of the rostellum, and come into contact with the extremely sticky surface of the saddle-shaped disc, which at once becomes attached. Consequently, as the insect withdraws its proboscis from the nectary, the saddle with its attached pollinia comes away, and the two flaps of the saddle instantly curl inwards, clasping and encircling the proboscis. The curling inwards of the flaps causes the pollinia to diverge, and as soon as the flaps have clasped the proboscis, the now divergent pollinia sweep forward through an angle of nearly ninety degrees towards the tip, until they have assumed such a position that, on the insect inserting its slender proboscis into the nectary of another flower, they will be brought simul-

taneously into contact with the two stigmatic surfaces. The flowers of the Pyramidal Orchid are visited by both day- and night-flying Lepidoptera; the day-flying insects being attracted by the bright purple tint of the flowers, which as the evening draws on give forth a peculiar strong odour very attractive to certain night-flying moths. How eagerly moths frequent the flowers of this Orchid we realize when we read Darwin's account of how he found a moth with no less than eleven pairs of pollinia attached to its proboscis.

The beautiful, creamy-white flowers of the Butterfly Orchid, which give forth such a delightful fragrance in the warm early summer evenings, are also eagerly visited by night-flying moths, who act as the carrying agents of the pollen masses from one flower to another. Other English Orchids which we should try to find and examine while growing in their natural environment, are the Fly Orchid, with its soft brown and black flowers, which though rarely visited by insects, yet require their help for the setting of the seed; the Spider Orchid, the labellum of which resembles in shape and colour the body of a spider; and the Bee

Orchid, which is adapted for self-pollination.

Our examination of the flowers of some of our British Orchids, and of their wonderful mechanism for obtaining the benefit of cross-pollination through the visits of insects, will naturally stimulate our curiosity to find out what other flowers do to obtain the same benefits, and we shall not be disappointed in our search. Indeed, we shall find that an almost endless variety of special devices, modifications and adaptations of the different parts of the flower, exist for the purpose of attracting various species of insects. We shall find flowers so formed that it is only possible for them to be pollinated by particular insects, so that some are dependent upon the visits of Humble Bees, Wild and Hive Bees, others upon Wasps, or various species of Flies, Moths and Butterflies. Our investigations will also prove to us that it is by no means always the same part of the insect to which the pollen is transferred; while the very means of transference from the stamens on to the part of the insect selected is most varied, the pollen being sprinkled, rubbed, or pumped on to the insect.

Thus the Humble Bees and Hive Bees, which delight to visit the nodding flowers of the Borage, have their abdomens sprinkled with pollen while they are busy sucking at the honey supplied by the flower, and the pollen so taken up is rubbed off on to the stigma of the next Borage flower visited by the bee. The flower of the Comfrey has peculiar scales with sharp prickles, placed in such a position that any insect visiting the flower is afraid to insert its proboscis anywhere except at the apex of the cone formed by the anthers, with the result that it is the head of the insect which is sprinkled with pollen. The Sweet Peas of our garden will offer us a most interesting example of a flower that has what is termed a pumping apparatus, by means of which the pollen is ejected on to the under surface of the bee. The fragrance of these delightful flowers always recalls the exquisite lines in which Keats described them—

> "Here are sweet peas, on tiptoe for a flight;
> With wings of gentle flush o'er delicate white,
> And taper-fingers catching at all things,
> To bind them all about with tiny rings."

If we take a flower of the Sweet Pea and

imitate the effect produced by a bee alighting upon it, which we can do by gently pressing with two fingers upon the wing-petals of the flower, we shall see that the keel is depressed with the wings, causing the stigma and anthers to be thrust upwards and partially uncovered, so that they would come into contact with the under surface of the visiting insect. Directly we remove the pressure the petals resume their former position.

As we wander through the fields we shall have many opportunities of examining the flowers of the Birdsfoot Trefoil (*Lotus corniculatus*). They are very much like miniature golden Sweet Pea blossoms, and their mechanism is very similar, but they have certain points of distinction which are very interesting. Before the flower opens or the petals have attained to their full size, the anthers burst and emit their pollen, which fills the pointed end of the keel. It is the five inner stamens which mature first, and having discharged their pollen, shrivel up and lie in the broader part of the keel; while the five outer ones, not yet mature, and somewhat swollen, lie immediately behind the pollen mass, and keep it in place at the

pointed end of the keel. An insect alighting on the wings of the flower depresses them and the keel, so that a portion of the pollen and the tip of the pistil are forced out at the point of the keel against the chest of the visiting insect. In this way, the stamens acting as a piston, a portion of the pollen is pumped out on to each bee that visits the flower, and at the same time the stigma is brought into contact with the pollen-laden hairs on the under surface of the insect.

The old adage that familiarity breeds contempt is all too true, and is the cause of our missing many unsuspected beauties, and leaving unnoticed many objects of interest. The common White Dead-Nettle (*Lamium album*), for instance, we brush aside daily in the course of our walk through the lanes, while should it dare to assert itself in the garden we pull it up and toss it aside as a common weed, with never a thought even to bestow upon it a casual glance, to see if it has anything of interest to reveal. It is only the common Dead-Nettle, a common wayside weed, and with that hasty, self-sufficient explanation we dismiss it as unworthy of further consideration. And yet, if

we trouble to examine it a little more closely, we shall find that in very few flowers is the adaptation of the various parts to the visits of insects more clearly shown than in this wayside weed. Of the truth of this we must be convinced by Lord Avebury's account of the structure of the flower, and his description should also help us to realize how much we may miss of the beautiful and interesting in Nature, through neglecting to look a little closer at objects so familiar to our sight that we have come to imagine we know all about them. In describing the flower of the Dead-Nettle, Lord Avebury states: "The honey occupies the lower contracted portion of the tube, and is protected from rain by the arched upper lip and by a rim of hairs. Above, the narrower lower portion of the tube expands and throws out a broad lip, which serves as an alighting-place for large bees, while the length of the narrow tube prevents the smaller species from obtaining access to the honey, which would be injurious to the flower, as it would remove the source of attraction for the bees without effecting the object in view. At the base of the tube, moreover, there is a ring of hairs which

prevent small insects from creeping down the tube and so getting at the honey. Lamium, in fact, like so many of our wild flowers, is especially adapted for Humble Bees. They alight on the lower lip which projects at the side, so as to afford them a leverage, by means of which they may press the proboscis down the tube to the honey; while, on the other hand, the arched upper lip, in its size, form and position, is admirably adapted not only as a protection against rain, but also to prevent the anthers and pistil from yielding too easily to the pressure of the insect, and thus to ensure that it should press the pollen which it has brought from other flowers against the pistil. The stamens do not form a ring round the pistil, as is so usual. On the contrary, one stamen is absent or rudimentary, while the other four lie along the outer arch of the flower, on each side of the pistil. They are not of equal length, but one pair is shorter than the other; the inner pair in some species, the outer pair in others, being the longest. Now, why is this? Probably, as Dr. Ogle has suggested, because if the anthers had lain side by side the pollen would have adhered to parts of the bee's head,

which do not come in contact with the stigma, and would therefore have been wasted; perhaps also partly, as he suggests, because it would have been deposited on the eyes of the bees, and might have so greatly inconvenienced them as to deter them from visiting the flower. Dr. Ogle's opinion is strengthened by the fact that there are some species, as, for instance, the Foxglove, in which the anthers are transverse when immature, but become longitudinal as they ripen. But to return to the Dead-Nettle. From the position of the stigma which hangs down below the anthers, the bee comes in contact with the former before touching the latter, and consequently generally deposits upon the stigma pollen from another flower. The small processes on each side of the lower lip are the rudiments of the lateral leaves with which the ancestors of the Lamium are provided. Thus, then, we see how every part of this flower is either—like the size and shape of the arched upper lip, the relative position of the pistil and anthers, the length and narrowness of the tube, the size and position of the lower lip, the ring of hairs, and the honey—adapted to ensure the transference, by bees, of pollen from one

flower to another; or, like the minute lateral points, an inheritance from more highly-developed ancestors. If we compare Lamium with other flowers we shall see how great a saving is effected by this beautiful adaptation. The stamens are reduced to four, the stigma almost to a point; how great a contrast to the pines and their clouds of pollen, or even to such a flower as the Nymphæa, where the visits of insects are secured, but the transference of the pollen to the stigma is, so to say, accidental. Yet the fertilization of Lamium is not less effectually secured than in either of these."

We have already made ourselves familiar with one member of the Buttercup tribe, the little Lesser Celandine, which we watched during our Springtime rambles. Now most of the members of this tribe are very much in evidence in the fields and lanes, and we shall find that their flowers offer many points of interest. Take, for instance, the golden flowers of the common Bulbous Buttercup, which make the meadows look so bright and gay in early Summer. We must look at both the unopened bud as well as the expanded blossom. In the bud we shall see that the calyx consists

of five sepals which cover and protect the unopen flower; but as the calyx opens each separate sepal turns down in such a way close against the stem, as to form a kind of lobster-pot trap, which most effectually prevents creeping insects like the ants from getting into the blossom to steal the honey. Ants are most unwelcome visitors to the majority of the flowers, for these restless little insects crawl up one stem after another, stealing the honey from every flower they come to, and not, like the bees, confining their attention to one kind of flower at a time. If you watch an ant by the wayside, you will see it climb up the flower stem, say, of a Buttercup first, then it will come down and ascend the very next stem that lies in its path, perhaps a Dandelion; from this it may go on to a Vetchling, a Speedwell, a Herb-Robert, Chervil, and so on. It is obvious that even supposing the insect brought away on its almost hairless body pollen from a flower, the chances of that pollen reaching the stigma of a flower of the same species would be very remote indeed, and consequently we shall find that the flowers have a number of contrivances, such as the bending back of the sepals, dense hairs,

or sticky hairs on the stem, by means of which they keep the ants away. Now the bees work in a very different way, confining their attention entirely to one species at a time, so that you might follow a bee for several hours, or, indeed all day, and you would find that if the first flower that it visited in the morning was clover, only clover flowers would be visited for the rest of the day, all other flowers being ignored. But to return to our Bulbous Buttercup. As the sepals bend back, they disclose the five golden-yellow petals, each with a tiny honey gland, protected by a small scale at its base, and the numerous stamens and carpels in the centre. To ensure cross-pollination we shall find that the carpels and stamens do not ripen simultaneously, but that the stamens first mature from without inward, so that a bee or fly visiting the flower at this stage only takes up pollen. Then later, when the stamens have discharged their pollen and withered, the carpels ripen, and are pollinated with pollen brought from flowers in the earlier stage by the bees and flies. Other interesting members of the Buttercup tribe are the Columbine, the Larkspur and the Monkshood, each with its

own special contrivance for attracting the visits of bees and butterflies. In the Columbine the petals have become long spurred horns, each with a supply of honey stored within the horn well out of reach of any insect not possessed of a long proboscis. In the Larkspur the five bright-coloured sepals are prolonged into a spur, which covers and protects the spurred nectary composed of the petals, reduced to two in number and united together to form the nectary. This double covering appears to protect the nectary from the attacks of certain thievish insects, who would otherwise bite through the nectary at its base and so steal the honey, without coming into contact with the stamens or carpels and pollinating the flower. Lastly, in the Monkshood the upper sepal is developed so as to form a brilliant blue hood to cover the two curiously-shaped petals containing an abundant supply of honey.

The Red Valerian has a curious and rather interesting arrangement for protecting its store of honey from small robber insects. The corolla-tube, which is about twelve millimetres long and hardly one millimetre in diameter, is divided longitudinally into two tubes by a

membrane; the style being lodged in the upper tube, while the store of honey is contained in the lower one, which is lengthened into a spur. This lower tube is lined with hairs in such a way that, while they present no obstacle to the long and slender proboscis of a large insect, yet most effectually prevent tiny insects from creeping in and carrying off the nectar. Another little plant that cleverly guards its nectar, and is to be found growing in the fir-woods of Yorkshire, Northumberland and Scotland, is the Linnæa, so called in memory of the great naturalist Linnæus, by whom it was much admired. It has a slender trailing stem, about a foot long, with short, erect flowing branches, bearing sweet-smelling, gracefully-drooping, pinkish, bell-shaped flowers. Ants are very numerous in the woods where the Linnæa grows, but are quite useless to the plant as agents for the transportation and transposition of the pollen, therefore it has to guard against these unwelcome visitors, who would not only rob the honey nectaries, but by their presence within the flower would most effectually frighten away welcome guests. To guard against the incursions of the ants the Linnæa

has its calyx covered with a dense growth of short and sticky hairs, which most effectually keep these undesirable visitors at a distance.

That form, colour and scent are all important factors in attracting insects to the flowers, is obvious, and during our Summer rambles we shall have many opportunities for observation. Although bright colours and sweet scents are very attractive, they are not all-sufficient to obtain the constant and continued visits of insects, so we shall find that many bright-coloured but scentless flowers offer an abundance of pollen, far more than is necessary for the purpose of pollination, and that by this means they supply an attractive banquet for their winged visitors. The bees are all most industrious insects, working ceaselessly throughout the long, hot Summer days amongst the flowers, and when we come to observe them at their labours, and the blossoms they visit, we shall see how wonderfully each has become adapted and modified to the requirements of the other; for while in many instances the flowers are necessary to the support of the insects in the final winged stage of their existence, these insects are absolutely indispensable to the

existence and continuation of the species of the flowers. Many brightly-coloured flowers we shall find have distinctive patches or lines of colour upon their sepals and petals which serve as guides leading to the honey nectaries. The large and handsome flowers of the Wild Yellow Iris, which grows on the margin of the mill-pond, offer a striking example. Its sepals are large, brilliantly coloured, marked with dark conspicuous guiding lines, all converging inwards, and hang down gracefully, forming admirable alighting platforms for the visiting Humble Bee. The petals are smaller and erect, and the stigmas are so expanded as to resemble petals in appearance, and arch over the stamens in a very curious manner.

A large proportion of the sweet-scented, or white-coloured flowers which are visited by night-flying insects, give out little or no scent during the daytime, and have a drooping, almost faded appearance, until the approach of darkness. On the other hand, many flowers whose petals have been widely expanded throughout the long, bright day, fold them closely as the sun sinks to rest. Indeed, we shall find that flowers, like human beings, have

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1. TWELVE O'CLOCK, NOON, THE FLOWERS OF THE ESCHSCHOLTZIA ARE WIDE AWAKE.
2. SIX O'CLOCK P.M. THE ESCHSCHOLTZIA FLOWERS TIGHTLY FURLED AND SOUND ASLEEP.

their regular hours for rest, if not actual sleep, so that it is possible under favourable conditions to make a close guess at the time of day by observing which flowers are expanded and which are closed. But the accuracy of our floral clock will be found to depend upon the climatic conditions, many flowers remaining closed or only very partially expanding on dull chilly days. Of this sleep of the flowers, we shall find many examples amongst the plants growing in the flower borders of our garden, which will offer us material for observation at any hour of the day or night. The Eschscholtzias, whose orange-coloured flowers looked like dainty drinking-cups at midday, present a very different appearance when we visit them at sunset, their petals being closely furled for the night; while the Nicotinas, which presented such a woeful, dejected appearance in the noontide blaze of sunshine, now shine out like white stars in the gathering dusk, and fill the night air with delightful fragrance. As we wander down the lane in the soft, still twilight, we shall see that the Wild Rose has closed her delicate pink petals, like tired eyelids in quiet sleep, the flaunting Poppies, and the pink,

scentless Campion have followed her example, but the White Campion and the Honeysuckle are awake, watching the stars and making the warm night fragrant with their lovely perfume. Demeter silently draws near and whispers softly her message of hope in our ear—

> "for—while my hand exults
> Within the bloodless heart of lowly flowers
> To work old laws of Love to fresh results,
> Thro' manifold effect of simple powers—
> I, too, would teach the man
> Beyond the darker hour to see the bright."

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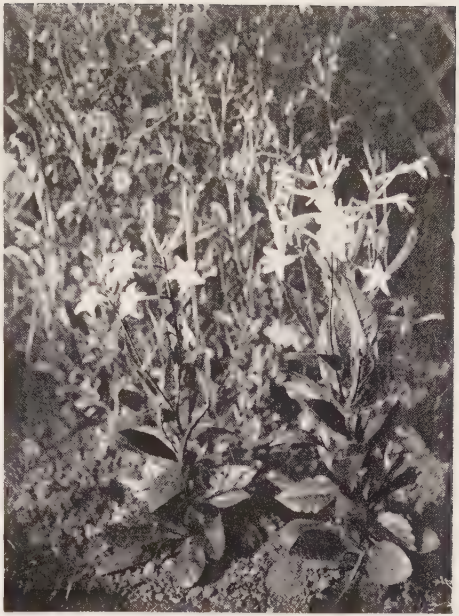

2

1. TWELVE O'CLOCK, NOON, THE FLOWERS OF THE TOBACCO PLANT ARE SOUND ASLEEP
2. SEVEN O'CLOCK P.M. THE FLOWERS OF THE TOBACCO PLANT ARE WIDE AWAKE, THEIR WHITENESS SHINING OUT IN THE GATHERING GLOOM, AND THEIR SCENT MAKING THE TWILIGHT FRAGRANT

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CHAPTER VII

SUNDEW, BLADDERWORT AND BUTTERWORT

We must try during the Summer, if possible, to spend one or two long days upon the marsh and moorland, the haunt of the Lapwing in the Spring, that we may see three very remarkable plants growing in their natural environment; namely, the Sundew, the Bladderwort, and the Butterwort. These three plants are not content with drawing their supply of food material from the air, the soil, and the water, but have special devices for the capture of insects, fresh-water crustaceans and the like, from whose bodies they draw a further supply of nitrogenous material; and from this curious and remarkable habit they have been called carnivorous or insectivorous plants.

We will first seek for the Sundew, because it is most abundant, and the commonest of this remarkable trio. We must look for it on the marshland, nestling loosely-rooted amongst the dense growth of bog-moss, which forms a

beautiful background to its reddish-coloured sparkling leaves. It nestles close down in the moss, its rosette of three, five, six or more leaves extended horizontally from the stem, and generally nearly prostrate, though sometimes standing nearly erect. The leaf-stalks are generally fairly long, and terminate in the round, salt-spoon-shaped, or oval, mustard-spoon-shaped leaves—according to whether we are looking at the Common Sundew (*Drosera rotundifolia*), or the rarer oval-leaved Sundew (*D. Anglifolia*). From the centre of the rosette rises a slender reddish stalk bearing a number of very small white flowers which open wide to the brilliant morning sun. The surface of each leaf is covered with numerous club-shaped hairs, that look as if they were tipped with dew, giving the leaf a very pretty sparkling appearance in the bright sunshine, and from which the plant has gained its popular name of Sundew. But these hairs are really very remarkable organs indeed, tentacles perhaps conveys a better idea of their character, for they are sensitive to the lightest touch of a midge, yet indifferent to the rain-drops, and, as we shall see, have digestive and

absorptive powers. Their bright sparkling appearance renders them both conspicuous and attractive, so that we shall not have long to wait to learn their true character. While we await the approach of an insect, let us more closely examine a leaf. We shall see that the hairs or tentacles are very numerous, from 130 to 260 or more, and that each terminates in a knob or gland, surrounded by a large drop of extremely viscid secretion which sparkles and flashes in the sunshine. The tentacles on the central part of the leaf are short, erect, and have greenish stalks. Nearer the leaf's margin they become longer and longer, with pale purplish stalks; those on the very edge project outwards or are slightly curved like slender fingers, the longest, which are nearest the base of the leaf-stalk, sometimes measuring nearly a quarter of an inch in length. The oval glands are about $\frac{4}{500}$ of an inch in length, and secrete the viscid fluid.

And now let us watch and see what happens when an insect approaches one of the tentacle-clad leaves of the Sundew. Innumerable gnats and midges are on the wing, dancing in the warm sunshine, and hovering over the

sparkling leaves of the Sundew. One of these insects, probably attracted by the glittering appearance, alights on a leaf, and is at once entangled in threads of sticky secretion from every gland that it has touched in alighting. The more the captured insect struggles, the more hopelessly does it become involved, its wild movements only serving to bring it into contact with other tentacles and causing them to pour forth an abundant secretion. As the insect in its struggles to free itself touches more tentacles, we shall see that they begin to move, gradually bending over towards the centre of the leaf, which itself becomes slightly concave. The incurving of the tentacles has the effect of moving the insect to the centre of the leaf, and at last they close over it like long snaky fingers until the leaf looks like a closed fist. The secretion poured forth by the glands of the tentacles permeates the captured insect so that the soluble parts become dissolved and digested, and the products of digestion absorbed. The feast finished, the leaf and tentacles once more expand, the glands for a while cease to function, and the dry skin of the insect is soon blown away by the wind; and

after a period of rest the leaf is ready for another meal. It is not only gnats and midges that are caught by this remarkable plant; much larger insects, such as small moths, Daddy-longlegs, and sometimes even dragonflies falling victims. Occasionally a leaf captures too large a meal, and pays the penalty of greediness. The Sundew was made the subject of most careful observation by Darwin, and the results of his patient and elaborate investigations are contained in his fascinating book on "Insectivorous Plants." He showed the extreme and apparently selective sensitiveness of the tentacles, which, unaffected by gusts of wind or falling raindrops, yet respond to a morsel of human hair, weighing only $\frac{1}{78740}$ of a grain. How sensitive to nitrogenous material the tentacles are, he demonstrated by the immersion of a leaf in a solution of phosphate of ammonia, so weak that each gland could only absorb about $\frac{1}{20000000}$ of a grain, which proved quite sufficient to produce complete inflection of the tentacles.

Francis Darwin, continuing his father's experiments and observations, has further added to our knowledge of the benefits the

Sundew derives from its carnivorous habit. Thus, taking six plates full of thriving Sundew plants, he divided off each by a transverse bar, and selecting the least flourishing side of each plate, he began, on the 12th of June, 1877, to place morsels of roast meat weighing about $\frac{1}{50}$ of a grain on the leaves, renewing the supply from time to time. The result of this regular supply of nitrogenous material soon made itself evident in the greener and more robust appearance of the fed leaves, and before the experiment had continued for two months, the number of flower-stalks were half as numerous again on the fed plants as on those plants which were not supplied with the morsels of meat; the number and size of the leaves, and the colour of the flower-stalks of the fed plants all showing a marked superiority. In his detailed description of this experiment, Professor Francis Darwin states that "the flower-stalks were all cut at the end of August, when their numbers were as 165 to 100, their total weight as 230 to 100, and the average weight per stem as 140 to 100 for the fed and unfed sides respectively. The total numbers of seed capsules were as 194 to 100,

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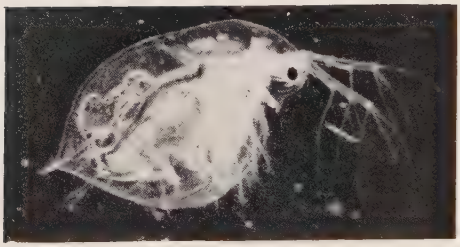

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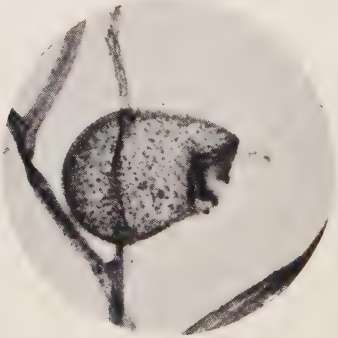

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1. LEAVES OF SUNDEW. ONE HAS CLOSED UPON A CAPTURED INSECT. 2. THE WATER-FLEA OFTEN FALLS A VICTIM TO THE BLADDERWORT. 3. A BLADDER OF THE BLADDERWORT

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or nearly double, and the average number of seeds in each capsule as 12 to 10 respectively. The superiority of the fed plants over the unfed was even more clearly shown by comparing their seeds, the average weights per seed being as 157 to 100, their total calculated number as 240 to 100, and their total weight as 380 to 100. The fed plants, though at the commencement of the experiment in a slight minority, were at the end of the season 20 per cent. more numerous than the unfed."

The Sundew grows but loosely rooted in the poor, wet, sandy soil of the marsh; soil which recent analysis has shown to be very deficient in nitrogen. This nitrogenous material is as absolutely necessary for the growth and development of the Sundew as is the carbonic acid gas which it draws from the atmosphere. Therefore we can readily realize the importance and value of the ability to supplement the meagre supply of nitrogen drawn up from the soil through the roots, with the more abundant supply obtained by the capture of insects by means of the tentacle-clad leaves. There is another important function which the glands of the tentacles

perform, and which probably helps in the taking up of nitrates and other salts in solution from the soil by the root-hairs, and that is by causing a profuse transpiration. The transpiration of healthy and vigorous Sundew plants is very considerable during warm sunny weather, the glands of the tentacles producing a copious secretion. One experiment which I carried out this Summer (1911) will serve to illustrate the amount of water absorbed and transpired by the plants. A dish measuring six-and-a-half inches by four-and-three-quarter inches, the surface of which was covered entirely by a vigorous growth of Sundews, was placed in an open situation in my garden, where the sun would shine upon it from about half-past six in the morning until half-past twelve noon; this situation being selected as closely resembling that from which the Sundews had been obtained, and they were kept under observation from June 6 to July 17. During the whole period the plants were kept supplied with a liberal amount of measured rain-water, the average quantity of rain-water absorbed and transpired by the plants in forty-eight hours being about twenty ounces. The flowers

began to open about eight o'clock, were generally fully expanded shortly after nine, and closed with the passing of the sun. A dish of the same size was placed beside the one containing the Sundews, to roughly check the amount of water lost by evaporation, containing a similar quantity of peat-earth covered with a thin layer of dead bog-moss to take the place of the sheltering foliage of the Sundews.

The Butterwort (*Pinguicula vulgaris*), though not so common as the Sundew, is to be found in similar marshy situations; it loves the high wet moorlands and the banks of a mountain stream or beck flowing down from the hills. The little plant has a rosette of plump, glistening green leaves prostrate on the ground, and a beautiful violet flower on a slender upright stalk. The plant owes its quaint name Pinguicula, *i.e.* little fat one, to its plump leaves, which have a slight fungus-like smell attractive to midges and small flies, and are covered with stalked and unstalked glands, which exude a copious viscid secretion. Like the Sundew, the Butterwort is indifferent to raindrops, or sand grains blown by the wind, but pours forth an abundant secretion when touched by a little

insect. Under such stimulation the plump little leaf will move, curling slowly inwards so as to enclose the captured midge and bring it into contact with as many glands as possible, which pour forth their digestive secretion so that in a little while nothing remains of the insect save a few indigestible chitinous fragments. The Butterwort has long been known and used by the Lapps for curdling milk, in the same way that rennet is used in England.

And now let us try to find a specimen of the Bladderwort. We must seek it in marshy lochs and sluggish, polluted dykes, where, during the Summer, it floats at the surface, sending up from the submerged floating stem a flower-stalk bearing quaint, somewhat orchid-like golden blossoms. The Bladderwort has no roots, but its straggling stem bears numerous, much-divided slender leaves, among which are the hundreds of little bladders that have gained the plant its popular name, and which, when full grown, measure nearly $\frac{1}{10}$ of an inch in length. Each bladder, really a specially-modified leaf, is a hollow, semi-transparent chamber, entered by a thin trap-door or valve, which opens inwards only, permitting no

egress, for it shuts instantly and firmly against a special collar or projection around the mouth of the bladder. Throughout the Summer the Bladderwort floats on the surface of the water, its straggling stem growing at one end as it dies away at the other. Then as Autumn advances it becomes gradually more concentrated in its growth, so as to form a thick-set terminal tuft, and sinks on to the soft mud at the bottom of the pond, where it passes the Winter. With the return of Spring the plant, probably lightened of the reserve stores of material contained in its tissues for Winter use, once more rises to the surface, forms new bladders, and makes vigorous growth. Formerly it was supposed that the very numerous bladders served to act as buoys, keeping the plant afloat, but this is not the case, for the plant can float just as well when all the bladders are full of water, or, if they are removed, being kept floating by the air contained in its intercellular spaces. The true function of these bladders is the capture of the minute water-animals which swarm in the lochs and dykes. Those curious little crustaceans called from their lively, jerking movements

Water-fleas, and which swarm in the sluggish, tainted waters where the Bladderwort grows, fall ready victims to its numerous bladder-traps. Six or seven long, stiff, bristle-like processes project from the mouth of the bladder, and on to these the Water-flea scrambles, possibly attracted by a slight mucilage exuded from glands on the trap-door. The Water-flea cannot see into the interior of the bladder, but its curiosity and interest becoming aroused, it touches the trap-door and finds that it will yield, opening inwards. Possibly, probably, the pressure of the exploring crustacean, causes some microscopic organisms forming part of the natural food of the Water-flea to escape from the interior of the bladder, so that the little creature thinks it has discovered a rich store-cupboard, and, hastily pushing open the spring-door, enters. The door shuts with a snap behind it, and the adventurous Water-flea finds too late that this is no pleasant dining-room which it has entered, but a veritable chamber of horrors, for on the floor of the chamber lie the bodies of other Water-fleas, friends and relations who have recently mysteriously disappeared. In

vain it seeks to make its escape, but the door which yielded so readily from without cannot be opened from within, the impure gases soon overcome the struggles of the Water-flea, and it dies. The bladder has no digesting secretion like the Sundew and the Butterwort, but putrefactive bacteria take its place, and the products of decomposition brought about through their agency are absorbed by the Bladderwort. Water-spiders build their diving-bell nests among the branches of the Bladderwort, probably because in this situation they find a plentiful food supply.

On our tramp homewards from the haunt of the Sundew we pass a stretch of rather poor, stony ground, on which numerous members of the Thistle tribe seem to flourish, including the handsome and interesting Teasel. Its name takes us back to the days of the hand-loom, when the Teasel was cultivated and used in the dressing of rough-surfaced cloth, but to-day it is being replaced by specially-devised machinery, and so we find it, a more or less neglected weed, growing in waste places. As the Summer advances, we shall find that the basally-united leaves of the

Teasel have become perfect cups, partially filled with water, in which innumerable gnats and other insects have been drowned. According to the number of dead insects floating in the leaf-cup, so putrefactive organisms will be found to be more or less abundant, and Professor Francis Darwin was the first to draw attention to the fact that protoplasmic filaments, apparently emitted from gland-cells within the cup, float in this fluid, and probably absorb the fly-broth formed by the decomposition of the drowned insects. But we must not too hastily assume that this is the sole function of these protoplasmic filaments. Let us for a moment consider the environment of these wild Teasels. They are growing on poor stony soil, and in an exposed position where the midday sun will beat down fiercely enough, scorching the ground, so that only sturdy plants like the thistle tribe can subsist, for their roots strike deep down into the soil, and their thick, spiny leaves and stems are well protected. It is an environment where the struggle for existence among the plants is a hard one, for they have to face the dangers of excessive transpiration, the rapid drying of the

THE CUPS FORMED BY THE LEAVES OF THE TEASEL
BECOME FILLED WITH FLUID IN WHICH
MANY INSECTS ARE DROWNED

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soil, and probable lack of nitrogenous material in the earth. Therefore to be able to have an additional source from which to draw supplies of moisture to combat excessive transpiration, and nitrogenous material for the building up of tissue and stores of reserve material, is of immense importance and advantage, and it would seem that in this dual capacity we have the solution of the function of the protoplasmic filaments within the water-filled, cup-shaped leaves of the Teasel.

CHAPTER VIII

THE POND IN SUMMER

"The quick-wing'd gnat doth make a boat
Of his old house wherewith to float
To a new life!"

THE pond has undergone considerable change of aspect since we visited it in the Spring, what time the frogs were spawning. The willows, now in full leaf, cast their grateful shade at noontide, while a luxuriant growth of reeds and rushes fringe its margin. On its surface float miniature green islands composed of colonies of duckweed, and at one corner where the stream enters, a mass of the white flowers of the Water-ranunculus catches the eye. Over a shallow corner innumerable Gnats gyrate in an endless rhythmic dance, rising and falling in the warm sunlit air. Let us pause for a while here, even at the risk of receiving one or two bites from the bloodthirsty female Gnats, and see what we can make out of their habits. If our eyes are keen, we shall see here

and there floating on the surface, the empty pupa skins from which the dancing Gnats have not long emerged. For a short time, just sufficient for the Gnat to dry and expand its wings, the cast-off pupa skin from which, through a slit in the back, it had just emerged, served the little insect literally as a boat or raft "wherewith to float to a new life." Prior to this important event, the Gnat had spent the early stages of its life beneath the surface of the pond as a strange-looking wriggling creature. At first, as a larva, the insect rose tail-first to poke the respiratory tube at the end of its body through the surface of the water; and then, a little later, on reaching the nymph or pupa stage of its existence, the Gnat, now looking as if its head and shoulders had become encased in a semi-transparent diver's helmet, beneath which the wings and slender legs of the perfect insect might be dimly seen, reversed its position, coming up head first, so that the two slightly-curved blunt horns upon its back through which it now draws its supply of air, might be thrust above the water. Finally the insect rose sufficiently high in the water to thrust its back well above the surface,

then the skin so exposed, dried, cracked, and the perfect winged Gnat emerged. This curious life-history of the Gnat is well worth the trouble of carefully watching, for in all its essential details it is practically the same as that of the Anopheline Mosquito of tropical countries, which transmits to man that terrible tropical disease called malaria. One of the triumphs of biological study has been the discovery of the curious relations which exist between the organism which is the cause of malarial fever in man, and the spot-winged mosquito; for it is now known that the malarial parasite has to pass certain stages of its life within the body of the mosquito, and certain stages in the blood of man to complete its life-cycle; and that malaria can only be conveyed from one human being to another through the mosquito first biting a person suffering from the disease, and then biting another person. But I am not going to bother you on such a lovely Summer morning as this with an account of tropical diseases, particularly when there is so much of interest spread out before us.

Here, on the margin of the pond, several Dragonflies with slender, beautifully-tinted

THE MILL STREAM

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bodies and gauzy wings, are passing backwards and forwards in swift and restless flight, making a charming picture in the bright sunshine. At first, as we pause by the side of the pond to watch them, their movements seem aimless enough, but closer observation will show us that most of them are busily engaged in hawking after flies, for in spite of their graceful appearance, the Dragonflies are great hunters. Indeed, throughout their lives they prey upon other insects, so that they are veritable dragons of the pond. Like the Gnats, they spend the greater part of their lives beneath the surface of the pond, only they do not have to come up to the top every time they want to breathe, but extract the oxygen contained in the water. Down at the bottom of the pond they creep about, slowly and stealthily, amongst the water-weeds, presenting a strange, unlovely appearance, with their goggle-eyes, fat, cylindrical bodies, and longish, slender legs. Tucked away under the broad head, they have a most extraordinary telescopic underlip with a pair of sharp, hollow jaws, sometimes called the "mask," and which they shoot out to capture their victims. When ready

to undergo the final change in its transformation, the nymph crawls up the stem of one of the plants growing in the pond to the surface, and, resting there in the warm sunshine, soon dries. Its skin splits down the back, and the perfect Dragonfly makes its escape. It is at first very weak and limp, and it hangs by the side of the empty nymph-case, feebly moving its body and limbs, as if to make sure they are all right. But its beautiful gauzy wings soon expand and dry in the sunshine, and then with a sudden quiver it spreads them out and takes its first short flight.

I think that most of us have at one time or another, when standing on the banks of a particularly pretty pond or stream, wished that we could dive down beneath the surface and see for ourselves, like poor Tom in Kingsley's delightful *Water-Babies*, all the wonderful and interesting creatures that dwell there. You will remember in that charming story, that when Tom was changed by the water-fairies into a water-baby, he became very small indeed, and so could see quite clearly all the tiny little creatures that escape our notice when we peer down into the depths. Now although

we cannot, like Tom, become water-babies, nevertheless it is quite possible for us to-day to see as clearly as he did all the wonders of the water-world, for that wonderful magician's glass, the microscope, is no longer the costly instrument that it was when Kingsley wrote his beautiful fairy-story, and by its aid the minute wonders and beauties of Nature are revealed to us. A good student's microscope can be purchased for a comparatively modest sum now, and is a source of endless interest; it should be the treasured possession of every lover of Nature, for not only will it reveal countless unsuspected wonders of minute forms of life, but it will help us to find the answer to many puzzling questions.

And now, as we cannot dive down to the bottom of the pond and become water-babies, let us adopt the only alternative, and with the aid of one or two wide-mouthed glass bottles collect some of the objects we should so much like to watch. First let us nearly fill one of the bottles with water, and carefully place in it some of the duckweed floating on the surface of the pond. Then, if we hold the bottle up to the light, and look with a pocket magnifying

glass at the slender stems of the duckweed as they hang down in the water, we shall see that some of them have what looks like a tiny lump of greenish jelly fastened to them. With the exercise of a little care and patience we can safely transfer these stems to another glass, so that we can more clearly observe them. In a little while we shall see the minute lump of jelly begin to expand and elongate, and in a very few minutes a circlet of tiny tentacles will appear at the top and begin to wave about. The lump of jelly is really a living animal, and is called the Fresh-water Hydra. Though we can make out a good deal by the help of a pocket magnifying glass, we shall see and learn much more about this interesting creature if we place it in a watch-glass or shallow trough filled with water, and examine it under the microscope. Then we shall be able to see that in the centre of the waving circle of arms or tentacles there is a small opening, the mouth, into which particles of food are swept by the currents set up by the movements of the arms. The arms present a curious appearance, for they are not quite smooth, but seem to be covered with very minute bumps or swellings.

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1. THE HYDRA, A MICROSCOPIC DENIZEN OF THE POND
2. RANATRA, ONE OF THE WATER-SCORPIONS

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Each of these swellings is really a very remarkable cell, containing an infinitely tiny barb attached to a coiled thread, and these minute barbs are used by the Hydra in the capture of its prey, for the creature feeds upon other and still smaller inhabitants of the water. A tiny worm wriggling its way through the stems of the duckweed incautiously brushes against the waving tentacles of the Hydra, and in a moment is held fast by countless barbs shot out from the tentacles. The more the worm writhes and struggles to get away, the more closely does it become entangled, for in its efforts to escape it touches more of the swellings on the waving arms, causing them immediately to discharge their barbs, and in a very short time it is quite overpowered and soon disappears down the throat of the Hydra. If we are able to keep some of the Hydras under observation for a few days, we shall see many interesting incidents. It is not a very difficult matter, for they will live quite happily in a tumblerful of pond-water with a supply of floating duckweed on top for quite a long time; provided the sun is not allowed to shine directly upon the glass, and we take the trouble

to draw up and squirt back some of the water with a clean glass tube, an unused fountain-pen filler will answer admirably, so as to keep the water oxygenated. After a short time one of our Hydras will be seen to develop a little swelling on the side of its slender body, and the swelling soon grows so that it looks like a tiny knob or bud. It is not long ere the bud grows a set of tentacles, and, as a baby Hydra, starts fishing for its own food, and soon after this it breaks away from its parent and goes off to find a suitable spot to live in. We shall also see that our Hydras do not always remain firmly anchored in the same situation. Sometimes they let go their hold of the object to which they were attached, and allow themselves to float away, or use their tentacles to help them along through the water; or they may elect only to move a short distance along the plant-stem or side of the glass, and then they progress by slowly turning head over heels in a very careful and solemn fashion. First the Hydra bends over and grasps the stem of the water-weed firmly with its tentacles, then it releases the base of its body and slowly swings it right over, bringing it down on the

opposite side; and in this way, alternately grasping the stem with its tentacles and then with the base of its body, the Hydra moves along to its new quarters.

Attached to the older submerged stems of the Water-lilies, and to the stems of other water-plants, we may be able to make out, with the aid of the pocket magnifying glass, some tiny little tubes, scarcely an eighth of an inch long, and no thicker than a stout hair. The best way to find them is to place one short piece of the plant-stem at a time in a flat-sided collecting-bottle filled with water, and examine it with the pocket lens. We may not be successful at first, but it is well worth taking a little trouble to try to find them, for they are miniature towers built by a little creature called the Brick-making Rotifer. Under the microscope we shall see that the little tube is composed of tiny round pellets, placed side by side, and row upon row. As we look at this tiny tower, a little head pushes slowly and cautiously out of the top, and gradually expands until it looks almost like a beautiful silvery pansy, around the petals of which a delicate fringe of cilia are in constant, regular

motion. These rotating cilia produce a vortex current which carries all sorts of minute particles into the mouth of the Brick-maker. The undigestible portions are not wasted, but are formed by the Rotifer into the tiny round bricks or pellets with which it builds its tower. If we watch the little creature very carefully, we shall see that every now and then it stretches out its neck and for a moment bends its head over on to the side of the tower, and then contracts its neck again; and each time that it does this the Rotifer adds another brick to its house. It is possible with a little care and patience to make the Brick-maker build a parti-coloured tower; by supplying it for two or three days at a time with a little finely-crushed vegetable matter stained with a non-poisonous colour, using the leaves of the water-plants pounded in a mortar for the manufacture of this soup. All the Rotifers do not build castles of bricks, the beautiful Floscule, for instance, is surrounded by a delicate transparent envelope, into which it withdraws when alarmed; while others lead a gadabout, roving life, moving through the water with great swiftness. They are remarkable creatures, and have a world-

wide distribution, from the tropics to the frozen regions of the South Pole, where Sir Ernest Shackleton's Antarctic expedition found them living at the bottom of an ice-lake. Attached to the same piece of plant-stem as the Brick-maker, we may find a group of the beautiful Bell Animalcules, looking like fairy silver goblets on the slenderest of stems. Round the edge of each goblet there is a fringe of delicate cilia, kept in constant motion and producing vortex currents which carry the particles of food down into the mouth of the tiny creature. As we watch, an excited free-swimming Rotifer darts across the field, alarming by its rapid movement the little Bell Animalcules, who, with one accord, suddenly bob down, their slender stems contracting into graceful spirals. For a moment their cilia seems to cease work, and then, as the little creatures recover from their fright, the cilia once more begin their circular motion, slowly at first, but gaining speed at every stroke, carrying the cup-like body upwards, and causing the slender stem to unwind its spirals and elongate once more.

Even the black mud at the bottom of the

pond holds hidden wonders that our microscope will reveal. Taking a little of the oozy mud and placing it in a drop of water on a slide, we shall probably find when we come to examine it under the microscope that mixed up with it are one or two tiny specks of transparent jelly. These little specks of jelly are of very great interest, for they are the simplest, first form of life. So simple, so primitive are they that they take in food at any part of their bodies, and carry on digestion at any point within their bodies. Let us watch one of these jelly-specks which is called an Amœba. As perhaps you already know, it is formed of that substance called protoplasm, of which you and I and all the plants and animals are largely composed, only in the Amœba we find it in its simplest form, a transparent film containing the watery, slightly granular, jelly substance. At first the Amœba seems but a roundish, motionless speck, but as we watch it closely we shall see that there is a slight movement in the granular substance, and the tiny thing begins to change its shape. Gradually one part of its body begins to bulge, and then another, each slowly growing outwards like fat

flat fingers, and it is not long before we are able to see that the Amœba is slowly but surely moving along, elongating and contracting first one part of its body and then another. Perhaps one of those beautiful, one-celled microscopic plants called a Diatom lies in the path of the Amœba we are watching. The Amœba continues its progress, glides up to the Diatom, presses against it, and literally engulfs it, so that we can see the Diatom now within the Amœba. Now it is impossible for the Amœba to digest the whole of the Diatom, for this tiny plant absorbs the silica from the water, and works it up into the most beautiful and practically indestructible skeleton, so if we are able to keep the Amœba under observation, we shall see that in a little while all the soft parts of the Diatom disappear, having been dissolved away and digested, leaving the skeleton quite clear and clean. Then our Amœba begins to move along again, and streams away, leaving the skeleton of the Diatom behind. After the Amœba has increased to a certain size, it elongates so that a waist is formed and it has somewhat the appearance of an hour-glass; gradually the

waist grows smaller and smaller until at last it parts in the middle, and our friend has become divided into two Amœbas. These in turn will move slowly about in the mud on the floor of the pond, engulfing their food and streaming away from the indigestible parts; will increase a little in size, and then divide in two, in just the same way as the Amœba we have watched. There is something very wonderful, very awe-inspiring in this simple life-history of the Amœba, when we realize that we have been watching the primeval type of life; and that what we have been able to see with the help of our microscope, has been going on unchanged through the long ages ever since life first appeared in the waters of the earth as they began to cool; and will continue long after we and all the complex forms of life around us have passed away, and will probably be the last living thing to disappear from the face of the dying world. The rocks of the beautiful Malvern Hills, considered among the most ancient of our English hills, are hardly older than the first ancestor of our Amœba, and down through the long geological ages with their changing types of higher plant and

animal life, this, the primitive form of life, has remained unchanged.

The Diatom which we saw the Amœba engulf comes of a pretty ancient stock, though probably not so old as the Amœba, but the silicious skeletons of its ancestors form considerable deposits in some geological formations. The Diatoms have a world-wide distribution, and are to be found in salt as well as fresh water, and their tiny skeletons are among the most wonderful and beautiful objects revealed by the higher powers of the microscope, for so small are they, and so minute and delicate their markings, that only by the use of the highest magnifying glasses do they become visible. That olive-coloured scum floating on the surface of the pond contains thousands of them, mixed up with many other simple but equally interesting forms of life. When we look at some of these living Diatoms in a drop of water under our microscope, we shall see that some of them are capable of independent movement, passing slowly across the field of view. Probably we shall also notice some small green objects like little crescent moons in shape, moving about

among the Diatoms; they are a brighter green, and have no wonderful, indestructible silicious skeleton, and are called Desmids; moreover, they are only to be found in fresh water. They vary considerably in shape, and every pond will be found to contain some examples. We shall very likely find along with our gathering of Desmids and Diatoms a number of tiny spheres that look as if they were made of a green lattice-work woven by fairy fingers. If we look very carefully, we shall see that each sphere has a number of cilia on its outer surface by means of which it is able to move through the water. The little sphere is called a Volvox, and is not only a very beautiful object, but a very interesting one, for it belongs to that borderland between the vegetable and animal kingdoms, whose inhabitants have some of the characteristics of both plant and animal life, making it very difficult to determine definitely to which they really belong.

Each time that we visit the pond during the Summer months we shall find something new and interesting to attract our attention, and we shall not have paid many visits before we begin to realize that practically every order of insect

life is represented among its inhabitants. Further observation will show us that many pass the greater part of their lives beneath the surface, and that within the compass of this pond we have indeed a rich store-house of subjects for our consideration. The life-histories of all the pond-dwelling insects are most interesting, and it would need many bulky volumes to describe them all in detail; in fact, there are many whose complete life-cycle has never been seen. Many, like the Dragonfly and the great Dytiscus Water Beetle, are veritable dragons of the pool during the larval stage of their existence, and are the terror of all the weaker and smaller inhabitants. But while the perfect Dragonfly quits the pond, and roams the water-meadows and lanes in search of prey, the adult Dytiscus Beetle remains an inhabitant of the pond throughout its life, except for occasional flights in the evening, or to migrate from one pond to another. During both the larval and adult stages of its life the Dytiscus is a most bold and aggressive creature, fearlessly attacking all the other inhabitants of the pond, and taking toll of the tadpoles, newts, and even the minnows and sticklebacks.

In our rambles along the quiet lanes, and through the fields and woodland, we have had many opportunities of observing the special contrivances by which the plants have adapted themselves to their environment; contrivances for gaining the greatest possible amount of air and sunshine, and for the transport from one flower to another of their pollen, either by the wind, or through the visits of insects. We shall do wisely to apply the same method of observation to the insect inhabitants of the pond, seeking by close and careful observation during the different stages of their life-histories to make out what special contrivances they possess for their particular mode of life. We shall find that the contrivances by which aquatic insects capture their prey are very remarkable and varied. The Dytiscus larva has a pair of powerful, sharp-pointed jaws, with hollow tips through which the insect sucks the blood of its victims. In the Dragonfly larva we have the extraordinary "mask" already mentioned, while the Phantom larva, the larval stage of a very handsome gnat, has a circular fringe of stout bristles arranged like a lobster-pot, which close the back of the

mouth, and in which the unfortunate victim is held and its soluble parts dissolved and digested. In the Water Scorpion and Ranatra, the prehensile fore-legs are developed into a sort of clasp-knife mechanism for the capture of prey. Means of locomotion are equally diverse. The Whirligig Beetles dart backwards and forwards upon the surface and plunge into the depths when alarmed, the Pond-skaters and Ranatra run or row swiftly upon the surface, and the Water-boatman rests at the surface or rows swiftly about, back downwards, by means of its oar-like legs. The gnat larva moves through the water by a curious half-wriggling, half-lashing action of the body, while some Dragonfly larvæ swim by striking the water with their long bodies, and others by the sudden and violent expulsion of water from their intestines. The different methods of respiration in aquatic insects are most remarkable, some rising head, tail, or back uppermost to the surface, drawing their supply direct from the atmosphere by the help of antennæ, felted hair, and dorsally-placed spiracles, bristles, and hollow tubes capable of automatic expansion and closure; while others

breathe only the air dissolved in the water, and have equally well-adapted organs for the purpose. Here, then, is material to our hand, the examination of which should keep us busy for many a long day, and can but fill us with admiration and wonder, as we realize and more clearly understand the beauty and perfection of these natural adaptations.

But now the sun is beginning to cast long shadows across the pond, warning us that it is time we left its fascinating margin and turned our steps homeward through the glowing fields of fast-ripening corn. There is half-an-hour to spare yet, so let us steal softly round through the whin-bushes to the edge of the rabbit warren, and, screened from view, watch the young rabbits at play. At our approach they all scamper off down into the safety of their burrows, but if we keep quite still and have come up against the wind to take up our position, we shall not have long to wait for their reappearance. Soon a head is cautiously raised above the entrance of a burrow, and then an old buck comes out and snuffs the breeze. He sits up high on his haunches and cocks his ears, all on the alert and ready to bolt

YOUNG RABBIT "FREEZING." NOTICE THE TENSE POSITION OF THE EARS

YOUNG CUCKOO

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for cover at the slightest sound or scent of danger. Satisfied that all is well, he lops back to the burrows and stamps once or twice with his powerful hind feet, giving the signal that the coast is clear and the young Rabs can come out to play. And in a very few minutes out they come, dear soft grey, furry little creatures, and frisk about, or sit side by side like little babes of the woodland, nibbling the short, sweet grass. So with a last lingering glance at this peaceful, happy scene, let us wend our way homeward in the gathering dusk.

CHAPTER IX

BIRDS AND INSECTS

I HAVE been watching a little Mother Willow Wren all the morning, and she has taught me at least one useful lesson, and would also have proved to me, had I not been convinced long since by watching other bird friends every Spring and Summer for many a year, how utterly impossible it is for man to hold his own against the ravening hordes of insects that would quickly lay waste his crops but for the help of the birds. Every Spring and Summer countless swarms of caterpillars hatch out from the eggs deposited by various butterflies and moths, and would very quickly devour every leaf in our orchards and every plant in the fields and market gardens, were it not for the ceaseless war made upon them by those birds who capture them as food for their young and for themselves. If ever there was an instance of the many being persecuted for the sins of the few, we have it before us every year in the

cruel and senseless slaughter of the insect-feeding birds, doomed because of the depredations of the House Sparrow, and because when insect food is scarce in early Spring toll has been taken of a few already-infested fruit buds. Numbers of insects lay their eggs during the Autumn in cracks and crannies in the bark, or under the protecting Winter scales of the buds, and it is for the tiny larvæ which emerge from those eggs early in the Spring and enter the swelling buds that the Tits and Wrens and other insect-feeding birds so diligently seek. Surely, because we have neither the instinct nor knowledge, call it what you like, to detect without picking it to pieces a sound bud from an infested one before it shows palpable outward signs of the destruction being wrought within, that is no reason why we should at once take it for granted that the birds who depend for their living upon the capture of these insects are not endowed with a keener perception, or instinct, than we possess? I venture to say with the strongest conviction that the smartest of us would cut but a sorry figure if pitted against one of these insect-feeding birds in a competition for a reward to the one who found

the greatest number of insects in a given area and space of time. The fact is, we are all a great deal too puffed up with the idea of our own importance and superior knowledge; but with all our higher (?) education, and vaunted civilization, and railways, and steam-ships, and motor-cars, and flying-machines, we cannot find our way across the ocean and the wilds, and over great continents without map or compass to guide us, as do the birds which we so thoughtlessly destroy. What do we know of that great mysterious call of Nature that brings the birds, winging their way over the trackless deep, northward to our shores every Spring, and of that migration southward toward the tropics when the chill breath of Autumn tells of the departure of Persephone? All night long the lighthouse-keeper hears their cries and the beat of their wings, as young and old birds pass on their long journey southward. At the coming of the cold grey dawn, on the lonely Lincolnshire flats, their voices come to the silent watcher, calling through the silvery mists, the wailing cry of Nature's tired children, as they rest their weary wings ere starting on their long flight across the ocean. The Martins

that built beneath the eaves of our cottage this Summer will, we know, return again next year if all is well and no accident befall them; though between their departure and return many months must elapse, and many thousand miles across sea and land be traversed, with only that wonderful thing which we so lightly call "the homing instinct" to guide them. What would not our bold aviators have given to possess but a little of that "homing instinct" when the fog wreaths wrapt them round, and they lost their way in trying to fly round this little island! Their carefully-drawn route-maps, their compasses, and all the other clever devices designed to help them on their way, were useless when the darkness of the night drew down, yet all night long our swallows will wing their way unerringly across the deep. No, we are but children, and very ignorant, self-opinionated, greedy ones at that, playing on the sands of Time, and the little knowledge of which we are so proud, and so stuck up about, does not amount to a handful of pebbles. The sooner we realize how abominably ignorant we are concerning Nature's laws, and really try to use our eyes and minds to see and under-

stand how they affect us, and how we are, after all, only a little insignificant part of the great and wonderful universe, the better it will be for all of us. We can only hope to be healthy and happy by leading simple, honest lives, trying to help those who are less fortunate than ourselves, and to bring to them joy, and love, and reverence for Nature's immutable laws.

And now to return to my little friend the Mother Willow Wren. To-day has been a very eventful and exciting one for her, for early this morning her four eager, restless little fledglings left the carefully-screened, dome-shaped nest, built low down in a tangle of bushes on the edge of the marsh. She is a most confiding little bird, and we had become on quite friendly terms, so that I could come quite close to the nest without disturbing her, first as she brooded her eggs, and later when busily engaged in feeding her hungry youngsters. Last evening the young birds were very restless, squirming and constantly moving in the nest as if they could bear their cramped quarters no longer, so that it was evident they would quit it this morning. They must have flown soon after sunrise, for although I was

up betimes, when I arrived at the edge of the marsh the nest was deserted, and I could hear them rustling among the bushes and calling excitedly to one another and to their parents, who were flitting from branch to branch anxiously watching and scolding the too venturesome young ones. As the sun mounted higher in the deep blue sky, the sweet early morning breeze began to fail, and the air grew hot, so that it was not long before the youngsters were glad enough to perch on a shady bough for a rest, and to be fed with plump green caterpillars by their parents. Then it was that my little, graceful, feathered friend taught me a lesson. Poor wee anxious bird, she was very tired, and her plumage quite soiled and untidy with her ceaseless labours to supply her offspring with food. Twenty times in ten minutes had I seen her arrive with a beakful of insects to poke down the gaping throats of her hungry children, so you may guess how hard she had been working. One fluffy youngster to whom she seemed to pay particular attention had settled itself on the dead, lichen-covered bough of an old thorn quite close to where I sat watching, and I had been much

amused at the way the little creature fluffed up its feathers and gurgled with delight every time its mother arrived and poked a nice juicy caterpillar down its throat. It was to this bough that Mother Willow Wren came at last to take a short rest from her labours. She arrived with a tiny caterpillar in her beak, and with this she fed her youngster before she began to preen and smooth her ruffled plumage. The little one gave a sleepy twitter as if its hunger were at last appeased, and settled itself contentedly on the bough. But not for long was mother bird permitted to enjoy her well-earned rest; hardly was she half-way through her toilet ere the youngster suddenly roused up from its doze and gave vent to a loud chirp. Mother bird replied with an assuring little note, and continued her toilet operations. This, however, by no means satisfied her offspring, who, after giving her a few minutes' grace, again began to twitter. The little mother bird looked askance at the fluffy, restless youngster, as if to say, "Dear me, are you a young bird or a bottomless bag that I have been trying to fill with insects all the morning?" Then she bent forward with that

quick movement which she has when about to feed her young, and the baby bird, filled with expectation, opened its beak wide and fluffed out its feathers. Mother bird inserted her beak in the cavernous mouth, and tickled the back of the youngster's throat, and he, thinking he felt an extra large caterpillar, gave a gulp and an ecstatic chirp, and sat back on the bough quite contented, under the impression that he had swallowed another meal. By repeating this performance two or three times Mother Willow Wren successfully deluded the youngster, and obtained her much-needed rest. Well, while this little comedy was being enacted, I sat quiet and learned my lesson, for here was a means by which I, too, might be saved some labour. At home I had a young, nearly fully-fledged Cuckoo, which had fallen out of a nest and been picked up and brought to me. It was a fearless, lusty youngster, quite uninjured, and in a few hours had accepted me as its foster-parent and become quite tame. The difficulty, however, was in the early hours of the morning, when the young Cuckoo, who slept in an old hedge-sparrow's nest placed in a hastily-improvised cage by my bedside, awoke

and called shrilly in my ear to be fed. Granted we took what looked like a good supply of caterpillars, or small worms in a box, to bed with us, yet there never seemed to be quite enough to last until it was time to get up, even when we did remember each time we were awakened in the "wee sma' hours" to replace the lid on the caterpillar box before dozing off again! But here, at last, was a solution of the difficulty; Mother Willow Wren fooled her youngster by tickling the back of its throat and making it swallow imaginary caterpillars, when she wanted a rest, and I would do the same with my hungry Cuckoo. So, thanking my little feathered friend for her useful lesson, and wishing her long life and happiness, and the successful rearing of many families, I departed homewards, determined to take a straw as well as the usual supply of caterpillars to bed with me, so that I might tickle the back of my Cuckoo's throat when the supply began to run short, and then obtain with the help of the straw a longer rest. The plan worked admirably, and my Cuckoo grew up strong and healthy, and one day spread his wings and flew away on his long southward journey.

We have seen how important are the relations between the perfect winged insects, the butterflies and moths, and the flowers, for the transference of the pollen from one flower to another. Our little Willow Wren has shown us another aspect, for although by her labours she was doing us, indeed, good and invaluable service by destroying countless caterpillars which, if left unchecked, would devour our crops, she has shown herself a relentless foe of the insects. Here, then, is another aspect, another strand in the complex web of life. We have seen that the plants have various ways of protecting themselves to a less or greater degree from their foes, now let us see if we can discover how the insects guard against the onslaught of their numerous enemies. From watching the birds so assiduously feeding their young with caterpillars, we have already realized the significance of the large number of eggs which most insects are capable of producing, but this is only one way by which they escape extinction, and would hardly suffice unaided; indeed, as our studies widen, we shall find that the production of immense numbers of eggs and young is always present in species

that are preyed upon by many foes in the early stages of their existence. We have a striking illustration of this in the case of the masses of frog spawn which filled the ponds and ditches in the early Spring, for out of the thousands of tadpoles that emerged very, very few succeed in developing into perfect frogs.

Well now, the beautifully-arranged and classified specimens in the entomologist's cabinet are not going to help us one whit in learning how the insects guard against the attacks of their numerous foes. Like all other questions relating to Nature's children, we can only hope to obtain the true answer from Nature's own lips, as it were, by watching the plants, and animals, and insects, while they are alive and in their natural environment. And even then we shall only grasp the full significance of it all by constant, patient and faithful observation, approaching the subject with open, unprejudiced minds, freed from all more or less foolish preconceived ideas to lead us astray, but in all humble simplicity as children asking simple questions of the great Earth-Mother. And so long as we approach her in this spirit, and ply our questions, she

WHITE ADMIRAL BUTTERFLY ASLEEP ON
BLACKBERRY BLOSSOM

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will lift the veil from our eyes that we may read her answer true, whether it be written on the flowers of the field, on the delicate markings of the butterfly's wing, the grey rocks of the mountain, or the ever-changing forms of the clouds at sunset; and will walk by our side, as we wander along life's dusty highway, revealing new secrets, fresh beauties and wonders to interest, cheer and encourage us on our way; so that in our joy and eagerness to learn all she has to tell us we shall forget the stones that bruise our feet and the thorns that stretch out to tear us, and come at last, though old in years, still with the trustful heart of a little tired child, with that last question on our lips that shall be answered when our eyes close in our long, last sleep.

Come, then, let us up and away to the Oak Copse, this bright summer morning, brushing the sparkling dewdrops from the nodding grasses as we hasten along the narrow winding path. If we spread out a cloth, or hold an inverted open umbrella under the branches and give them a short, sharp, sudden tap, quite an odd collection of insects will fall down: spiders, flies, small moths, a beetle or two, and

several green, brown, or greyish caterpillars. The spiders and beetles scramble off in a great hurry, and the flies and moths quickly take wing, but the caterpillars will probably at first remain motionless, some of them curled up tightly, others stretched out full length as if quite dead. After a few minutes have elapsed, however, if we do not touch them or shake the cloth, we shall see them cautiously uncurl and walk away. This simulation of death on the part of the caterpillars serves two purposes; first, should a bird see them lying prone upon the ground it will look upon them with doubt and suspicion, and possibly leave them alone, lest they have died of some disease, for insect-feeding birds like to capture their prey alive; secondly, by remaining motionless where they have fallen they readily escape notice, and so can safely make their escape. We shall the better realize this if we tap another branch, without placing a cloth beneath it, for while we shall find it a comparatively easy task to pick out the spiders as they hastily depart, we shall have considerable difficulty in detecting any of the caterpillars.

Now let us examine more closely some of the slender, brown and grey caterpillars that have fallen out of the oak-tree. As they lie passively on the cloth or open umbrella, our first impression of them is that they look very much like little pieces of oak twig. Then, as they move off, we are struck by their peculiar gait, which is quite unlike that of any other caterpillars. Their legs are arranged in two groups, one at the head, consisting of three pairs set close behind each other, and two pairs of clasper legs right at the other end of the long, slender body. In walking, these caterpillars first grasp the stem or twig, along which they are making their way, with their front-legs, and then, drawing their hind-legs along, bring them close against the front ones, so that their body forms quite a loop. Then holding on firmly with the hind claspers, they stretch their bodies as far forward as possible, and so continue along the branch. It is from this quaint and very characteristic mode of progress that these caterpillars have gained their popular name of Loopers. Nor is this the only interesting point about them, for they have a very clever way of escaping observation when alarmed, and this

they accomplish by grasping the branch on which they are resting firmly with their hind-legs and then bending the body out at right angles to the stem, remaining absolutely motionless in this position until the danger has passed; and so wonderfully does the colouring of their bodies blend with that of the branches upon which they are resting that they look just like little leafless twigs.

We shall find that the caterpillars have several ways of escaping from the unwelcome attentions of their foes, for though many depend upon protective colouring, other means become necessary when the insect is more conspicuous in appearance. Some caterpillars are more or less covered with a dense coat of brittle hairs, which cause painful irritation if touched, as they readily enter the skin and break off. The caterpillar of the Puss Moth presents an extraordinary appearance with its swollen head and forked tail, and when alarmed or angered it rears its head and cocks up its tails, from the tips of which two brightly-coloured little filaments are rapidly shot in and out, and altogether puts on a most aggressive and alarming appearance. The caterpillar of the Lobster

Moth is another insect which frightens its foes away by assuming a threatening attitude. It is a most strange-looking creature, the end of its body being shaped something after the fashion of the claw of a lobster, while the front-legs are very long and slender. At the approach of danger this caterpillar grasps the bough upon which it is resting with its hind-legs, and moves its claw-like tail and waves its long slender front-legs about in the most uncanny manner. Bright colours, sudden sharp movements, and the secretion of offensive fluids are other methods, more or less successfully employed by the caterpillars against their numerous foes. The caterpillar of the Elephant Hawk Moth has a pair of circular markings upon its thorax, which, viewed from different angles, gives the front part of the insect the appearance of a strange-looking head with goggly eyes.

Even when caterpillar and pupa stage have been safely passed, the perfect winged insect has many foes to contend against. So we find moths whose wings closely resemble in colour the brown, fallen leaves, as is the case with the Lappet Moth, among which they rest during the

daytime; or, like the pretty little Buff-tip Moth, their markings may resemble the colour of the bark of those trees which they are in the habit of frequenting. And so effective is this protective coloration, that it takes a very quick and well-practised eye to detect the moth when it is at rest with folded wings, even when the observer is standing only a few feet away from the tree-trunk. Brilliant colours and eye-like markings play an important part in the protection of the Butterflies against their foes, in conjunction with their swift and often erratic flight. The beautiful eye-spots on the wings of our handsome Peacock Butterfly seem to glow and watch us, as the insect, perched on some blossom, slowly moves its wings. The brilliant prismatic play of colour, first on one wing, then on the other, of the gorgeous Purple Emperor Butterfly, appears to be very disconcerting to any bird giving chase, and is perhaps the best example in our native day-flying Lepidoptera of a means of protection, which reaches its greatest perfection in the swarming insect life of the tropics.

There is one sight that we may witness during the Summer, which should awaken our

interest and set us speculating afresh, and that is what is termed the "calling" or "assembling" of the Emperor Moth. It is a handsome moth, with soft grey and reddish markings, and an eye-spot on its broad wings. The "calling" is done by the female moth, soon after emerging from the cocoon, and so potent is the attractive powers of this little princess, that male Emperor Moths will come from far and wide to woo her. There appears to be a curious tremor of the wings and antennæ when she is "calling," but no sound reaches the human ear, yet I have known gallant courtiers to fly quite a mile from their natural haunts in response. If a recently emerged princess is enclosed in a little gauze-covered cage, and taken along the fringe of the heather, it will not be long before several courtiers are fluttering round us. I have had as many as twenty amorous little males all fluttering round me at once, striving to gain admission to the little princess in her gauze-covered cage. And then, when she has accepted one lucky fellow as her spouse, all the other little Emperors will take wing and fly away. We know very little about the

methods of communication which exist between insects, and when we come to critically sift what has been written on this most fascinating yet baffling subject, we shall find that it is mostly founded upon theory. That insects are capable of holding intelligent communication with each other, any one who has watched an ants' nest, or the entrance to a bee-hive, must be convinced. Indeed, an hour or two may be very profitably spent in the pine woods, watching the movements of the large Wood Ants, and examining their wonderful dome-shaped nests. You will there be able to see how the countless inhabitants are in constant communication one with another. How they are constantly running up to each other in questioning fashion, tapping each other with their wonderful, jointed, club-shaped antennæ, and then moving off again to continue their labours. Should a little syrup be placed on the ground at some yards' distance from the nest, it will be discovered by two or three ants who are out exploring for food supplies, almost at once; and in a very few minutes after making their discovery, communication will have been established between them and the nest, and

the patch of syrup will be surrounded by a dense throng of excited ants. In the same way, should a search party come upon some large object, such as an unfortunate Stag-beetle that has fallen on its back on the ground, where like an over-turned turtle it lies practically helpless, and which they would like to take back to the nest. In a very few minutes communication is established with other search parties, further reserves are sent forth from the nest, and the unhappy beetle is soon dismembered, joint by joint, and the fragments carried to the nest in triumph. The fate that overtakes a handful of ants introduced from another nest will convince you that they can readily distinguish strangers.

Watch the entrance to a hive, and you will see how those bees told off to guard it communicate with every member of the hive, leaving or returning to it. Should a stranger bee approach, thinking to slip in unnoticed to steal the honey, it is at once set upon, and unless it beat a hasty retreat, quickly killed. The antennæ of insects are really very wonderful and complex organs, and undoubtedly play a very important part as sensory organs by

means of which many insects communicate with each other. Should one of the antennæ become injured, the unfortunate insect shows every sign of distress, becoming most erratic and uncertain in its movements. Our microscope will reveal numerous hairs and pits on the surface of the antennæ, which are considered sensory centres, and will help us to understand what wonderfully complex organs they really are.

PART III

AUTUMN AND WINTER: THE PASSING OF PERSEPHONE

CHAPTER X

SOME OF NATURE'S MALIGNED CHILDREN

"The sun is set; the swallows are asleep;
The bats are flitting fast in the gray air;
The slow, soft toads out of damp corners creep,
And evening's breath, wandering here and there
Over the quivering surface of the stream,
Wakes not one ripple from its summer dream."

SHELLEY.

I OFTEN wonder why so many people have such a strong repugnance for the good old Toad, for I can hardly conceive a more harmless, friendly and useful creature. Yet he is still credited with all sorts of evil, called a nasty, slimy, loathsome thing, and otherwise basely maligned. The amount of inaccurate and un-natural history concerning the toad you can gain from the confident statements of supposedly well-informed, well-educated people is really most astonishing; and is an object-lesson of how legends which have once passed into popular belief are accepted without further thought or question as to the truth,

and are handed down from generation to generation. Most people will tell you that the toad is slimy, and many of them will gravely assert that it spits, and, if you are an inquiring child, that it spits venom, and that if you touch the horrid thing, your hands will most assuredly be covered with warts. Well, I am glad to say there is very little truth in these picturesque statements; and their only interest for us is that they are the remains of old legends which were accepted many hundred years ago, in the Middle Ages, by credulous people, who burnt poor, helpless, half-mad old men and women for witches and wizards.

Now the next time that we meet an honest toad sitting by the road, let us "draw up famijous like, an' get acquainted," as old Uncle Remus would say. We shall find that old Mr. Toad is a very dignified person; he does not get into a panic and hop and flounder away like a frog will, and if he is satisfied that we mean him no harm, he will sit by the wayside and regard us in the most dignified manner. Having made friends with him, let us try to find out if we can how the many malicious statements about the solemn old

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1. ANTICIPATION. 2. REALIZATION

THE TOAD ENJOYING A MEAL

[*To face p.* 191

fellow originated. If we gently pick up a toad that has not been alarmed, we shall find that its curious knobby-looking skin is cool and dry, no trace of slime at all. But if the poor thing has been chased and frightened, then very likely, as we pick it up, a great deal of water will come away, and its skin will be bedewed with moisture. Here we have the origin of libel number one. Somebody ever so long ago roughly handled a toad, and found that water exuded, and that its skin was moist and clammy to the touch. And very likely that person had a scratch on the hand, into which some of the moisture was absorbed along with some dirt, so that the scratch festered. Consequently the poor toad, who could not be held responsible for scratches or the unclean condition of his captor's hands, was ever after dubbed poisonous. As a matter of fact the exudation with which a toad's skin becomes more or less covered, when the creature is alarmed or angered, is slightly acrid, and employed as a means of defence against other animals that may lay hold of it. How nasty this acrid secretion must taste you will realize should you see the expression on the

face of a puppy making his first acquaintance with a toad, and how quickly and with what evident disgust he drops it. Every dog that lives in the country I suppose at least once in its life will mouth a toad, but I doubt very much if it ever repeats the experiment. The quantity of fluid which flows from a toad is water which the creature has absorbed through its skin, for the toad delights to sit in a puddle of water and soak, and absorb it like a sponge; particularly just before casting its skin. I have many pet toads, and they will sit in the shallow pan of water provided for them, and soak and soak, until they are nearly double their normal size. I think the libel about the toad giving you warts must have its origin in the warty, knobby appearance of the creature's skin, for both I and my wife constantly handle our toads, who have been our pets for many years, without ever feeling any bad effects. The origin of the myth concerning the spitting propensities of the toad is not far to seek, and had its foundation in the sudden forward movement of the head, and the lightning-like swiftness with which the tongue is shot out when the toad seizes its prey. So swift is the action,

that you very, very rarely obtain a clear view of the tongue. It is only when a toad is weakly, as in the early Spring after long hibernation, or when filled to repletion, that the tongue action becomes slow. In the early Spring, or when protracted cold has made the advent of Spring long in coming, lengthening the period of hibernation considerably, the toad becomes so exhausted that it will make several unsuccessful shots with its tongue before capturing a worm or a slug. A few days of genial warmth serve to revive it, and then caterpillars, worms, slugs and flies disappear swiftly down the throat of the hungry toad. What a toad can put away is really astonishing, for in the Summer one of our big pet toads will think nothing of taking fifty meal-worms, one after the other, as fast as we place them in front of him. Think what this means, if you are wise enough to encourage toads in your garden! There will be little need to go out at night to hunt for slugs.

You would hardly imagine, perhaps, from casual observation, that toads were capable of displaying much character or facial expression. But I assure you that every toad has its

individuality, and I hope the illustrations that you will find in these pages will help to convince you of the play of expression that passes over a toad's face. Offer a healthy, hungry toad a nice fat worm, if you would have ocular demonstration of his powers of facial expression. You will see how his eyes sparkle with excitement, and the tense eager expression as he bends forward to shoot his tongue out to seize the worm. Then, if he gets it by the middle, he will solemnly use his thumbs, first the right hand, then the left, or *vice versâ*, stuffing his capture into his capacious throat. Finally, notice the look of contentment and complacent satisfaction as he gulps it down, and waits for the next dainty to arrive. I well remember one toad we had who was a most amusing and greedy fellow. There were two large, rather elderly toads who lived with him, and who did not gobble up their share of the meal-worms with the same rapidity; consequently Ikey, as we called him, was full up long before they had finished. He would sit and look at them, his sides heaving, and with the most comical expression of woe and disgust upon his face, while they solemnly continued

HEAD OF TOAD, SHOWING LANDSCAPE REFLECTED IN THE EYE

[*To face p.* 195

their meal. He would turn sharply round and stare first at one, then at the other, as much as to say, "How can you keep on, when you see I have not room left for even half a meal-worm?" At last, when he could stand the sight of the fast-disappearing meal-worms no longer, he would bob forward and hit with his tongue first one and then the other of his companions as they bent forward, hitting them on the face or head, so as to make them miss their shot at the meal-worm.

During the Middle Ages, down probably to the close of the eighteenth century, large toads were much persecuted by old wives, alchemists, and other dabblers in what was called "the black arts" of necromancy, as the unfortunate animals were suspected of having a jewel or precious stone in their heads. This "toad-stone," as it was called, was supposed to have many virtues, and would bring health and prosperity to the fortunate possessor. Shakespeare brings this once generally-accepted myth into one of his plays, in the well-known passage beginning:—"Sweet are the uses of adversity; which, like the toad, ugly and venomous, wears yet a precious jewel in his head"—showing us

what kind of character the toad had in Elizabethan days. The reputed toad-stones were often highly polished and of peculiar shape, and were treasured possessions handed down from generation to generation. The belief in their efficacy lingered on to the close of the nineteenth century in isolated country districts among simple folk, for I remember in my student days, during a long vacation spent on a lonely part of Exmoor, being shown one by the good farmer's wife, at whose farm I was staying, the good soul insisting that I should wear it in a little muslin bag round my neck, that I might be restored to health. Certainly the end of the holidays found me healed of my sickness, and ready to take up the battle of life again, but I am afraid I put down my "cure" to the pure air and peaceful life of that wonderful tract of country. However, the farmer's wife was convinced that the charm had worked, and when some years later she and her sturdy husband and sons had to leave the old homestead, owing to bad times, and sailed away across the deep blue ocean to make a new home in the golden West, the old toad-stone went with them. May it have brought them better

luck in that land of promise! I have often speculated on the origin of the toad-stone myth, and I cannot help thinking that the creature's eye has had something to do with it. Keeping toads as pets for a number of years, as I have done, I have become fairly familiar with their ways and habits, and it is on these observations that I have founded my theory. Of course, like all theories, it is open to doubt, and I do not for one moment put it forward as the one and only correct solution of the origin of this myth. The eye of the toad is a most beautiful object, and when seen with the low rays of the setting sun reflected on its surface, it glows with all the fire of a precious jewel. Toads will often come out in the afternoon to feed, particularly if there has been a shower in the earlier part of the day to freshen things up, and by the added coolness bring the worms to the surface and slugs abroad. Now, after a hearty meal, or swallowing a tickly insect, a toad will sit and from time to time gape as if he would like to be quit of his meal. I have watched toads go through this performance again and again, and at a little distance seen the flash of reflected sunlight from the toad's

eye as the creature gaped. Now it would not take a very imaginative person, seeing this happen at a short distance, to suspect that the toad had vomited up a polished object, and on going up to the spot might possibly find a curiously-formed, weathered stone. If these stones had ever been common or uniform in shape and size, my theory, of course, would be absurd, but the "true tode-stone" of the old sixteenth and seventeenth-century herbalists, so far as I have been able to ascertain, was neither common nor uniform in shape or size; in fact, one of their methods of determining whether a stone was "true" or not, consisted in placing it before a toad, "when so eager is he to possess it, that he will dart forward to seize upon it," showing that even in those days the specialists themselves were not very certain as to what constituted a "true tode-stone." What a wonderful thing the eye of the toad is, the illustration facing page 195 may, I hope, help you to realize. If you will look at it carefully, you will see that reflected in the eye is a replica of the landscape facing the toad. You will see the bright disc of the setting sun shining between the trees bordering the opposite bank

of the ford, and the path of light made by the sun on the dark surface of the pond. As the old fellow sat on the bank, quite unconcerned at having his photograph taken, his lustrous eyes glowed like jewels in his head, and it was not until I developed the negative that I discovered I had not only taken his portrait, but this miniature picture reflected in his eye.

The general repugnance which people have for snakes is much more easily understood, for many, as we know, are swift ministers of death. In England we are fortunate in only possessing one poisonous species, the Adder, and the bite of that is only fatal or very serious under exceptional circumstances, generally due to the person bitten being in a bad state of health. The Grass Snake is quite harmless, and although not very intelligent, can become a very interesting pet; but they vary greatly, and some will always remain either very shy, or, more rarely, very aggressive. One very large and handsome specimen which I kept for some time remained absolutely untamable, always darting forward, striking and biting when touched, and finally made his escape into the woods. During his enforced stay with us, he

aroused the wrath of a Persian cat, who one afternoon gave a very remarkable display of hereditary instinct. The snake was out on my study floor for a little exercise, when the cat entered the room. The moment Puss caught sight of the snake, she crouched down flat on the floor and gave a deep growl. She then began to cautiously stalk the snake round the room until she got behind it, when she sprang suddenly out and over it, delivering a sudden blow with her paw as she passed, alighting at some distance, and at once turning to face her foe. This performance was repeated again and again, the snake rearing up its head and lunging at the cat, who deftly avoided it, returning stroke for stroke, until I parted the combatants, fearing lest one or other should be injured. But there on the floor of my quiet study, in my cottage home nestling among the Surrey hills, had been enacted such a scene as forms part of the daily battle of life and death in the tropical forests. This Persian cat, at the sight of an hereditary foe, had been transformed from the complacent, well-fed, gentle Pussy into the very incarnation of feline wrath, though who shall say how many generations of

cats intervened between her and the last of her ancestors to do battle with a snake in her jungle home?

Probably one of the best places in which to study the Adder is the New Forest, for it may often be seen as Summer merges into Autumn, sunning itself at the entrance to a deserted rabbit burrow facing south, on the fringe of the moorland; which later on will form snug winter quarters for it. I should not call the adder a particularly aggressive snake; indeed, generally it is shy, retreating hastily at one's approach, though if cornered it will turn, and naturally make a good fight for its life. People generally get bitten through teasing it, or stamping on it in walking through long grass and heather, and although they are always very indignant about it, and say that the horrid snake was in the wrong, I really see no reason why an adder should be expected to submit quietly to being poked and hit with a stick, or trampled upon. There is one point about the adder which has yet to be satisfactorily settled, and that is whether the female at the approach of danger opens her mouth and allows her young to glide down her throat, and supposing

such to be the case, whether they safely make their retreat from such strange quarters after the danger from without has passed. That under certain circumstances the adder will swallow her young I think is highly probable, although I have never been fortunate enough to witness the act myself. Nevertheless, I have had this act described so accurately, again and again, by foresters and gamekeepers, men whose work has trained their eyes to observe minutely, and with such simple, genuine sincerity as to carry conviction that they at least believed what they stated they had seen. Many of these men have spent their whole lives in the forest, or on the wild moors of Yorkshire in the closest communion with Nature, and are first-rate "naturalists" in the truest sense of the word. Circumstances have placed them in a humble walk of life, but that has not prevented them acquiring a clear and deep insight into the wonders of Nature. Let us not forget that one of our naturalists of whom we should all be proud, and upon whom the Linnæan Society bestowed a coveted honour, old Thomas Edwards, was a humble cobbler by trade. Let us, therefore, not be too hasty

"HOW DARE YOU PHOTOGRAPH ME!"
THREE CHARACTERISTIC STUDIES OF THE BARN OWL

in dismissing as altogether unreliable the observations of such men. Not one of my informants had ever seen the young snakes return to the open air after disappearing down the throat of the mother adder, which seems to point, that while it is highly probable that adders under fear swallow their young, the luckless offspring perish through their parents' solicitude. We know that many other animals, under similar circumstances, will actually devour their offspring, so why not the adder? However, it is a question over which some people are singularly touchy and dogmatic, as narrow-minded folk are so apt to be about a matter that is not of very vital importance. So let us leave them to fight it out amongst themselves.

I often wonder when the ancient, superstitious and senseless hatred which so many country folk have of the Owl will at last die out. No bird, I suppose, has been more persistently persecuted and misunderstood, yet it is one of the best friends of the farmer, keeping in check the swarms of rats and mice that would otherwise take such heavy toll of his grain. Yet, partly because it is out and about

during the hours of darkness, partly because of an ancient and foolish tradition that it helps itself to the squire's pheasant chicks—the rats and the stoats are the real delinquents—the harmless and useful Barn Owl continues to be persecuted. It is a wonderful sight in the fast gathering gloom, to see the Barn Owl steal, like a dim white ghost, from out his favourite resting-place and fly rapidly away down the hedgerows and over the quiet fields. On swift yet silent wing he ranges over the stubble like some well-trained dog, ever drawing nearer to the ricks. Suddenly he swoops downward like a flash, a veritable feathered sword of Damocles, striking, and in an instant killing with his powerful, steel-hard claws his victim. It is a swift and silent tragedy, lasting but a few seconds, and at its close the farmer has one furry foe the less, and the owl a dainty morsel. Statistics, compiled from the careful examination of large quantities of the pellets cast up by the Barn and Brown Owls, have been published again and again, showing the enormous number of mice, rats and voles these birds destroy, but the persecution, though I think in some districts at any rate to a less degree,

continues. There is no doubt the silent, retiring habits of these birds, their liking for the hollows of mighty oaks in the forest, or old ivy-clad ruins as nesting sites and retreats in which to doze away the hours of daylight, their coming abroad on silent wing as the twilight deepens, and their shrill, weird call sounding through the dark night like the cry of some phantom or goblin, has had much to do with the almost universal mistrust and dislike in which they are held. Many and strange are the legends concerning the Barn Owl, and all appear to be of considerable antiquity. There is a pathetic little story of the beautiful daughter of a great king, and how she refused to give up her true lover, or listen to the blandishments of a false-hearted hypocrite who had gained the sanction of her father. Caught one cold winter's night during a secret interview with her lover, she was turned out of the castle by her irascible father, and, losing her way, perished in a terrible snowstorm that swept across the country. The old king, repenting too late his hasty act, sent search parties far and wide to find tidings of his daughter, but all in vain. The spirit of the unhappy princess entered the body of a

Barn Owl, which flies round lonely homesteads on wild wintry nights crying for admission, that it may warm itself by the glowing fire. In the dark days when the belief in witchcraft was universal, the owl was supposed to take part in the ritual of the Witches' Sabbath, and to be on the best of terms with the powers of darkness, and to fly in at the window of sick persons to carry off their souls to the Evil One. The appearance of an owl in broad daylight always presaged disaster and death, its alighting upon a house during the daytime being a sure sign of the rapidly approaching death of one of the occupants.

Owing to their nocturnal habits the Bats have gained quite as bad characters as the toads and the owls in popular folk-lore; yet they, in a lesser way than the owl, perhaps, do good service to the farmer by devouring large numbers of night-flying moths and other insects. However, as they have never been charged with stealing the squire's pheasant chicks, they have not been persecuted to the same degree as have the owls. Nevertheless, around these most interesting and useful animals many a grim legend has been woven. Probably one of the

most ancient, and at the same time most widely accepted, was the story of the Vampire Bat, that was said to flit in at the open casement window, and alighting gently on the neck of the sleeping occupant of the chamber, to suck his or her blood, gently fanning with its wings the face of its victim to induce sounder slumber, so that at last the unfortunate person sank into the deep sleep of death; and the Vampire, satiated with the life-blood of the sleeper, departed on silent wing in the grey of the dawn, leaving no trace save a faint mark on the neck of its victim to tell of the cause of the tragedy. Spending the hours of daylight snugly hid away in the darkest corners of old barns, ruins and holes in the trunks of trees, the bats come forth in the twilight, flitting hither and thither, turning, twisting, circling in rapid flight as they chase the night-flying insects. They are wonderful creatures, with their beautifully soft furry bodies and membranous wings. The larger species, like the Great Noctule and the Long-Eared Bats, may, with proper attention and care, be kept in captivity, and will grow sufficiently tame to come to those who daily feed them, and, if regularly exercised in a

room, will take freshly-killed flies or living meal-worms from the open palm or the back of the hand while on the wing. It is advisable, however, to take the precaution of closing all windows and blocking up the entrance to the fire-place, before letting them fly, otherwise they will be off up the chimney and far away before you realize what has happened. If the nights continue warm, you may see them hawking for an hour or two every evening during the Autumn, and indeed some seem to come abroad in Mid-Winter should we have a spell of mild weather; but the coming of the cold breath of approaching Winter drives them to snug, warm quarters out of reach of the frost, where they will spend the long Winter months in partial if not complete hibernation.

The Moles are also much-maligned creatures, for they do a great deal of good by devouring swarms of root-destroying larvæ, and in their burrows and excavations act as Nature's ploughs, turning and bringing to the surface fresh soil. But they work in the dark, underground, and therefore much evil is imputed to them. The speed with which they travel and dig their way through the earth is really

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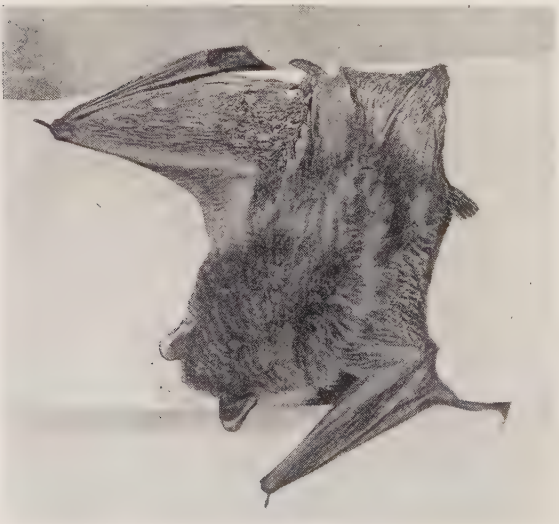

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1. THE MOLE. 2. THE BAT IS ONE OF NATURE'S MUCH-MALIGNED CHILDREN

[*To face p.* 209.

extraordinary, only to be matched by the number of worms and larvæ they will devour per day, if they can find them. Indeed, the mole cannot stand against abstinence from food for any length of time, but quickly succumbs to even a few hours' starvation. When we have an opportunity of examining a living mole, we quickly appreciate how well the animal is equipped, and adapted to its mode of life. The short, velvet-soft fur offers no resistance to the earth. The nose is long and pointed so that the fore part of the head and body form a cone, with its base at the greatest width across the shoulders. The legs are short and set close, offering as little obstruction as possible, the paws and muscles of the front pair being highly developed to enable the animal to dig its way rapidly through the soil. It is an interesting experiment to place a mole in a box containing a shallow layer of earth, which will enable you to watch the rapid, powerful action of its hand-like fore-paws. Only remember that Mr. Mole is a hungry fellow, who does not take kindly to captivity, and will soon die if kept from his dinner; therefore, after watching how quickly he digs through the

earth, travelling backwards and forwards across the floor of the box, more as if swimming through water than digging a way through soil, give him his liberty and see how swiftly he will force his way underground.

The Mole Cricket is the counterpart of the mole in the insect world. It is a quaint-looking creature, about three inches in length, of a soft greyish-brown colour. It is a comparatively rare insect in England, but fairly common on the Continent, where it sometimes does considerable damage in the market gardens by gnawing at the roots of the plants. Like the mole, it makes long galleries or runs underground, and excavates a little chamber in which the female deposits her eggs, just as the mole makes a nursery for its young. The mole cricket leads an underground life, rarely showing itself abroad in the daylight, though it likes to come out in the twilight, and, unfurling its beautiful wings, which remind us rather of the locust, take flight. It has a bluntly-pointed head, with fairly long and slender antennæ and handsome eyes. The thorax has a most beautiful sheen upon the upper surface, and is the broadest part of the body, which tapers in front

to the blunt-pointed head, just as in the mole, only rather more acutely. The front pair of legs present the most extraordinary appearance, being very strong, short, and terminating in a kind of comb-like claw, which bears considerable resemblance to the equally remarkable "hand" of the mole. The muscular power of these claws is very considerable, as you will quickly find out should you have an opportunity of handling a living specimen. The second, or middle pair of legs are slender, and used in running and walking, while the hind pair are very long, like the hind-legs of all the crickets and grasshoppers. Altogether the mole cricket is one of the most interesting and remarkable of our British insects.

With the approach of Autumn many of Nature's children are busy collecting stores of food, and seeking snug quarters in which to spend the Winter in partial or complete hibernation. The toads creep away into protected corners under stones and turfs, while the adders find snug quarters in deserted rabbit burrows. The old hedgehog excavates a hole in a sheltered spot on the fringe of the wood, and lines it warmly with dry autumn leaves and

bracken. The little dormice make a mossy nest, and, sleek and fat from their Summer feasting, are soon sound asleep with their tails coiled tightly over their noses to prevent frost-bite. The garden spiders seem to grow daily larger and fatter, thriving on the last of the Summer's winged insects; while every morning their wonderful geometrical webs shine and sparkle in the sunshine as if decked out with precious jewels. But Madam Arachne soon shakes the diamond dewdrops from her web, well knowing that no fly will blunder into its toils so long as it glitters in the sunshine. High up among the rafters in the barns and outhouses, and in hollow trunks of trees, the Tortoiseshell and Brimstone Butterflies have crept for their long Winter sleep. And so, as we wander through field and copse, on every hand we see signs of the approach of Winter and—

"The swallow flies away;
I would that I were he,
He follows the flown May
Across the sea."

AT THE APPROACH OF WINTER, THE DORMICE TUCK THEIR TAILS OVER THEIR NOSES, AND SINK INTO DEEP SLUMBER

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CHAPTER XI

PLANTS AND THEIR CHILDREN

"The banded sheaves stand orderly
Against the purple autumn sky,
Like armies of Prosperity."

The hot sunshine-laden air sweeps up the face of the Downs, bringing with it the clank and whirr of the reaping-machines, and the shouts of the driver as he guides his team round the cornfield. The exigencies of modern civilization have driven much of the romance and charm out of the harvest fields, and instead of being one of the most beautiful, ennobling scenes of rural life, symbolic of clean, honest, healthful toil and its reward, fragrant with the presence of Demeter, the great Earth-Mother, it is fast becoming a mere prosaic matter of clattering machinery. Nor can I believe this change, which is driving the agricultural labourer and his family from the cottage home and pure air of the open fields, into the crowded squalor and reeking atmo-

sphere of the town, a change for the better. Our sturdy yeomen have been the backbone of old England for many centuries, turning their ploughshares into swords, in time of trouble, to hold back the foemen from our island home; the men who have helped to make the greatest Empire that the world has ever known. Think you that their place can be taken by clanking, noisome, smelling machinery and the puny, neurotic offspring of the towns? We had best look to it ere it be too late, and our hardy yeoman stock has vanished never to return. If you have never had the good fortune to see a harvest gathered as it should be, by human reapers, where the golden corn bends to the stroke of the reaping-hooks plied by strong arms, then take down from your bookshelf Blackmore's *Lorna Doone*, and turn to the chapter wherein John Ridd tells of his Harvest Home, and you will read one of the most vivid, most touching descriptions ever written of a scene that once was one of England's glories.

Many are the lessons of harvest time, if we will but try to read them as we pass through the happy Autumn fields. We have come, as

it were, to the climax of the year, when Demeter, the great Earth-Mother, has spread abroad with lavish hands all her choicest fruits, that Persephone may have to cheer her, as she passes to the Under-World, the memory of the happy sunlit fields of golden grain, rich with the promise of prosperity, and of reawaking life to greet her when Spring shall once more herald her return. We are apt to think of harvest time only as the season when grain and fruit are gathered in for our own sustenance and comfort, forgetful of its wider significance of continued life; it is the Season which sees the crowning gift of children to the plants, for every grain of corn is a new life, a plant baby that may develop, and in due course perpetuate its species. Perhaps it has never quite struck you in this light before, and you have never thought seriously of seeds as real plant babies, only rather as something good to eat, or something that has to be planted in the early Spring, if we would have our garden gay with flowers. If this be the case, then I am, indeed, pleased to have been able to introduce another aspect of plant life to you, for it will open up another field of

observation and interest for you throughout the latter part of the Summer and the Autumn.

I am not going to trouble you with botanical definitions of fruit and seed, for it forms one of the most tiresome subjects in technical botany, swathed in a jargon of terms that may be got off by heart, and sound very learned, but will leave you still ignorant of the real significance of fruit and seed, or at most only help you to say that this or that particular fruit *probably* belongs to such and such species. The real significance of the varying characters of fruit and seed you can only truly understand and appreciate by examining them for yourself in their natural environment, using your botanical treatise as you would a dictionary. The pistil, after it has been pollinated and has matured, is called the fruit. In flowers like the Meadow Buttercup, where there are many carpels, the fruit consists of distinct parts —one-seeded little nuts; or in the Larkspur, which belongs to the same order, of many-seeded pods. The Poppy affords us an example of a flower where the carpels have combined to form a single ovary and many-chambered fruit, which when cut across will be

seen to consist of ten seed-bearing chambers. The majority of fruits are dry capsules or pods, either single-, double- or many-chambered. The Vetch, the Pea and the Laburnum will show us examples of single-chambered fruits; the Wallflower of double-chambered; and the Wild Hyacinth, the Poppy and the Campion, of many-chambered fruits. The fruit generally consists of as many carpels or as many chambers as the unfertilized ovary.

And now let us go for a long ramble through the lanes and fields and woodland, to visit our plant friends, to see if we can find out something about their children, and what they do towards giving them a successful start in life. We shall find that the plants vary greatly in the number of their children, and that the greater the number of plant babies the fewer that reach maturity. The problem of what is best to do for their children is a great one, for the parent plants cannot migrate from the spot where they are growing. Their roots have struck down into the earth and are drawing from it certain salts necessary for their growth and sustenance, and which the baby plants will also require when they begin life on their own

account. If their children remain close to them they will have only already partially exhausted soil for their roots, and as they grow up, will choke their parents by taking more of the sunlight and air. It at once becomes obvious that for their own well-being, as well as that of their offspring, the plants must do their best to send their children as far away from them as possible; so that the seedlings may have the best chance of springing up on unoccupied ground, and at such a distance as not to interfere with their own growth. Once we have realized this, we shall easily understand the reason for the existing diversity of forms of fruits, and we shall also hold the key to the solution of the dominance of certain species.

Now how can the plants best provide for the wide dispersion of their children? What are the agents of dispersion here? Insects, so useful and all-important in the transference of pollen, are obviously unsuitable, and so a little further investigation only is necessary to show us that the principal agents for the dispersion of seeds are the wind, birds, various animals, and, in a lesser degree, man. The wind prob-

ably comes first, while under natural conditions man would come last, although his selective methods of cultivation and his flocks would sooner or later have their effect upon the predominance of certain species. Fruits containing but one or two seeds are frequently dispersed entire, either falling to the ground, as is the habit with most nuts; or else they are provided with wings or parachutes which enable the wind to carry them far from the parent plant, and let them fall on unexhausted soil. These are the two methods that we shall find predominant among the trees in the woodland. If we look at a Maple-tree we shall see the familiar double fruit, which we have always called the Maple's Key. Now watch these keys when they are all ready for dispersion, on a windy day, and see how the gusts whirl them away, and how they are set spinning like tops by the air currents, which helps to sustain them in the air, so that a second and a third or fourth gust of wind may catch them and bear them yet farther away from the parent tree. In the fragrant Lime-trees we shall find another contrivance for dispersal by the wind. Here the common stalk of the

flowers is winged by a thin leaf, and when the little fruits are ripe the wind detaches them from the tree and carries them away by means of this common parachute. Other examples of one-seeded, winged fruits which are worth examining are those of the Elm, Birch and Ash. The acorn of the Oak is an example of a nut that falls directly to the ground from the widely-spreading branches of the parent tree, and although at first sight this may not appear to be a very effective method of dispersal, you will find that unless the acorn has the misfortune to fall into a crack or sharp depression in the ground, it rarely remains on the spot where it first alights. This you can prove for yourself by marking a number of acorns as they fall, and visiting the same spot from time to time during the Autumn, when you will find that they are gradually shifting their quarters, caught in the ground swirl of the Autumn gales, rolled along by the feet of passing animals. Examine the surface of an acorn as it rests on the ground, and you will realize the value of its highly-polished surface, enabling it to respond to a very light touch or puff of wind.

Where the seeds are contained in a pod-shaped fruit, as, for instance, in the vetch and pea, the fruit does not become detached, but opens on maturity, and swaying in the wind, scatters the seeds broadcast, their shape and smooth surface in turn helping them on alighting to roll farther from the parent plant. Capsule fruits generally open at the top, and this is of considerable advantage, as the seeds can only fall out when there is a sufficiently high wind to bear them some distance. As we wander through the cornfields we should make a point of examining the pretty urn-shaped poppy heads, or, if we can find none there, after the harvest has been gathered in, then those growing in the flower-border in the garden. We shall then see that there are openings in the upper-side of the capsule, and that it requires pretty violent shaking to bring out the seeds, so that it is certain that they can only be dispersed during very windy weather, when they are likely to be carried a considerable distance. Our common garden balsam and the little wallcress will furnish us with two familiar examples of another means of dispersion, namely, by forcible expulsion, the

valves of the fruit opening elastically and suddenly, so as to project the seeds, like stones from a catapult, to a distance.

The Dandelion's clock is not only a most beautiful object, but a very perfect contrivance for the dispersal of the seed. Each seed is attached by a very slender stalk to a most beautiful feathery parachute, something like a miniature white parasol turned inside out, which will carry the little plant baby safely away for miles. The Thistledown, again, is another perfect mechanism for wind transportation of seeds to great distances; indeed, so light and buoyant is it, that it is often carried on the wings of the wind not only into the very heart of great cities—I have seen it on more than one occasion floating down into St. Paul's Churchyard—but far out to sea; indeed, should suitable winds prevail during the seeding of the thistles, it is quite within the bounds of possibility for an interchange of thistledown to take place between England and France. Out on the marsh the beautiful silky heads of the so-called cotton-grass wave in the breeze like an army of white standards, and if we watch them closely, we shall see that ever and

SEED-HEAD OF COTTON-GRASS

"CLOCKS" OF THE DANDELION

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anon a little seed with its feathery parachute is detached and carried off by the wind. The wild Clematis has gained one of its popular names, that of "Old Man's Beard," from the long feathery growth attached to each carpel for the purpose of aerial transportation, the masses of which give the plant such a pretty appearance in the hedgerows during the Autumn.

And now let us turn our attention to some other methods by which the plants manage to give their children a start in life, and which depend upon birds and other animals instead of the wind. So far the fruits we have been examining would hardly be accepted as such by most people, for the popular definition of a fruit is something with a more or less delicate and brightly-coloured skin enclosing a luscious pulp, with a hard stone or a "core" in the centre. Yet the grey-green poppy head and the bright rosy-cheeked apple are both fruits, both receptacles containing the seeds. During the summer we have had ample opportunities of observing the importance of brightly-coloured petals for attracting the visits of insects, so we are quite prepared to realize the

advantages of brightly-coloured fruits. It is obvious that any fruit having a bright-coloured skin and juicy pulp would render itself not only conspicuous, but attractive as a food, and would be sought and devoured by animals. But this form of attractiveness would have its dangers, for should both seed and fruit be eaten and digested it would not help the plant towards the dispersal of its seed, but bring about the gradual extermination of the species. So we shall find that all pulpy edible fruits intended for the attraction of birds and animals have either very small tough seeds which will pass through the bird or animal's body undigested, or have their seeds protected by a hard, stony covering which will be thrown away when the bird or animal has finished eating the sweet pulp surrounding it. Of the first type the glistening fruit of the blackberry is a good example; while the cherry, the plum and the peach are all familiar types of fruits with a hard stone, within which the seed rests and is safely protected from injury. In the woodland, as we might expect, the birds play a very important part as the dispersers of seeds, and so we shall find many plants that

do their best to attract these feathered agents. The elderberry spreads great masses of shiny berries to tempt them, the hips and haws shine out from the darkening vegetation of the hedgerows, the scarlet holly berries stand out in varnished glory against the deep green of the foliage, the sprays of honeysuckle offer their berries from the top of the hedge, while on the banks the stout stems of the cuckoo-pints, crowned by a compact mass of vivid-coloured berries, look most tempting.

We shall generally find at the end of the Autumn afternoon's ramble, particularly if we have had to make our way through a tangled growth of vegetation, that our clothes bear tokens of our excursion in the shape of numerous burrs which are not easily detached. Here we have another method by which certain plants provide for the dispersal of their offspring. In this instance the plants compel the passing animals to carry out the work, often putting their unwilling agents to considerable discomfort. The fruits of the hound's-tongue, for instance, consist of four small nuts, covered with hook-like prickles, and these cling to the coats of dogs, sheep and cattle, becoming

entangled in the hairs, causing the animals much irritation, so that as they wander about they rub themselves against bushes, trees and fences to get rid of the burrs, and in this way disperse the seeds over new ground. Two other wayside plants which utilize this method for the dispersal of their fruits are the herb-bennet and the cleavers. In the tropics these burrs are very numerous, and in many instances are really quite formidable fruits, bristling with sharp hooks. The African grapple plant has gained its popular name from the fruits, which are prolonged into a pair of long, sharp-pointed hooks, just like a grappling-iron, and which become so firmly entangled in the coats of the animals passing through the dense vegetation that they are carried about for months. There is a curious wheat plant growing on the fringe of the Egyptian deserts that has a very remarkable fruit, hairy, and with two long slender awns, giving the fruit at a short distance the appearance of a rough-coated young locust. These awns are very sensitive to any change in the atmosphere, an increase of moisture causing them to twist and turn, still further heightening the insect-like

appearance of the fruit. Insect-feeding birds are apt to mistake these fruits for some dainty locust, and to seize them and carry them off to a short distance to some convenient perch, where, on finding out their mistake, they let the fruit fall. If the bird, as is very probable, has touched one or both of the long awns with its beak, the slight trace of moisture will be sufficient to stimulate them to movement, so that when the fruit falls to the ground again it is jerked about and is very likely to fall into one of the many cracks in the parched earth, where it will remain until the advent of the rainy season washes surface soil into the crack and buries it. The fruit thus successfully attained its mission, first the removal of the seed to a distance from the parent plant, and then the placing of the seed in an environment suitable for its germination. But, as even this brief survey has shown us, there is no need to go farther than our own country lanes and woodlands to find interesting examples of the different means by which the plants give their children a start in life.

As we pursue our investigations into the dispersal of fruits, many other points of inter-

est will arise, and new questions suggest themselves, so that each returning Autumn will hold new interests for us. It is a subject which abounds with fascinating puzzles, and as a study of the various members of the rose family will demonstrate, fruits often tend to show greater diversity of form within the limits of a single family than do the flowers. In the raspberry and the blackberry the fruit consists of separate carpels with soft, sweet outer coats, enclosing the tiny, hard, nut-like seeds. In the strawberry, the flower of which is very similar, it is the common receptacle that swells out and reddens, that is to say, the part answering to the central piece which comes out whole in the middle of a raspberry. So that what we throw away in the raspberry we eat in the strawberry. The plums and cherries have but one carpel, with a brightly-coloured, soft, sweet outer covering, the seed being contained in a hard and stony jacket. In the apple and pear we find the fruit crowned by the remains of the calyx, and on cutting the apple across we shall see that it consists of an outer fleshy part, which is the swollen stem, enclosing the true fruit, the core with a number of pips, the seeds. Now all

these fruits, so diverse in shape and structure, belong to the rose family, and will help us to realize how immense is the variety of plan and structure existing in even closely-related species.

CHAPTER XII

THE WEB OF LIFE

"Plants and animals, remote in the scale of nature, are bound together by a web of complex relations."

CHARLES DARWIN.

DURING our Summer rambles we have had many chances of observing the relations existing between wild flowers and insects, and of the part which environment plays in modifying the shape and character of plants—peeps at the complex web of life. The more that we are able to examine animate nature, always striving to seek the why and wherefore of things with open, unprejudiced minds, the more deeply shall we be impressed with the wonderful and complex character of Life, and of how all the different forms act and react upon each other for good or ill in the struggle for existence. As we have wandered home through the harvest fields, the great moon rising over the corn-stacks, we have caught a momentary glimpse of the grey and white of the Barn Owl, flitting on

silent wing across the fields, and on the outskirts of the farm buildings we have met Pussy stealthily prowling along the lane, both owl and cat intent upon the capture of the mice and rats attracted by the presence of so much grain. Who would at first suspect that upon the presence or absence of these two depends the amount of seed that the farmer will obtain from the red clover? Yet such is the case, nor is the red clover the only crop which Pussy and the owl protect. But the case of the red clover is so striking an example of the web of life, that I cannot do better than give you Darwin's own description :—

"I have found from experiments that humble-bees are almost indispensable to the fertilization of the heart's-ease (*Viola tricolor*), for other bees do not visit this flower. I have also found that the visits of bees are necessary for the fertilization of some kinds of clover—thus, 100 heads of red clover (*Trifolium pratense*) produced 27,000 seeds, but the same number of protected heads produced not a single seed. Humble-bees alone visit red clover, as other bees cannot reach the nectar. . . . Hence we may infer as highly probable that,

if the whole genus of humble-bees became extinct or very rare in England, the heart's-ease and red clover would become very rare, or wholly disappear. The number of humble-bees in any district depends in a great measure on the number of field mice, which destroy their combs and nests; and Colonel Newman, who has long attended to the habits of humble-bees, believes that more than two-thirds of them are thus destroyed all over England."

Both the cats and the owls eagerly prey upon mice, so that it is obvious that in districts where one or both of these natural enemies of the destructive rodents are numerous, the humble-bees will be present in greater numbers, protected from the ravages of the mice, and therefore a greater amount of clover seed will be set. This is borne out by Colonel Newman, who says—"Near villages and small towns I have found the nest of humble-bees more numerous than elsewhere, which I attribute to the number of cats that destroy the mice." Here, indeed, we have a striking illustration of the value of biological methods of investigation, showing us how wonderfully plants and animals are bound together in the battle of life,

PUSS HUNTING FOR FIELD MICE

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and opening to us yet further unsuspected fields of intensely interesting study.

While the red clover depends upon the presence of cats and owls to protect its humble-bee friends, there are some plants which appear to keep a small army of fierce insects to protect them from depredations of other insects. Thus we find a thistle, which, as it begins to expand its flower-head, is liable to have the florets injured by a small beetle alighting upon and devouring them, attracts by means of honey secretions at this stage numerous little ants. Here we see the ant in a new rôle, no longer the robber to be warded off at all costs, but as a champion, ready to do battle for the life of the flowers massed together in the capitulum of the thistle. And right valiantly do the little creatures fulfil their task, rushing up on to the head of the thistle at the approach of the beetle or any other winged insect, and opening and shutting their jaws, and cocking their tails up in the most threatening manner, and squirting out sprays of formic acid, should the foe continue to advance. Gradually, however, as the flower-head matures and passes the stage when its florets would be injured, the honey nectaries

cease to secrete, as the presence of the ants would no longer be of service, indeed, would be detrimental by frightening away those winged insects which would secure cross-pollination; and so, the little ants no longer finding supplies of honey to lick up, must needs quit the flower-head and seek supplies elsewhere. Belt has given us the following most interesting description of his observations of an Acacia which he found during his travels in Nicaragua, and of the curious relations existing between it and some small ants:—

"The thorns of the bull's-horn acacia are hollow, and are tenanted by ants that make a small hole for their entrance and exit near one end of the thorn, and also burrow through the partition that separates the two horns, so that one entrance serves for both. Here they rear their young, and in the wet season every one of the thorns is tenanted, and hundreds of ants are to be seen running about, especially over the younger leaves. If one of them be touched, or a branch shaken, the little ants (*Pseudomyrma bicolor*) swarm out from the hollow thorns, and attack the aggressor with jaws and sting. They sting severely, raising a little white

lump that does not disappear in less than twenty-four hours. They form a most efficient standing army for the plant, which prevents not only the mammalia from browsing on the leaves, but delivers it from the attacks of a much more dangerous enemy—the leaf-cutting ant. For these services the ants are not only securely housed by the plant, but are provided with a bountiful supply of food, and to secure their attendance at the right time and place, the food is so arranged and distributed as to effect that object with wonderful perfection."

At the base of each pair of leaflets on the bipinnate leaf of the acacia there is a sweet gland, and a little yellow pear-like body at the end of each small division of the compound leaf, which is carried off when ripe by the ant. When the ants first ascend the stems, they find the young thorns soft and filled with sweet pulp, their homes already filled with food, and as they hollow out the pulp, the thorn continues to increase in size, swelling out at its base. Belt, in continuing his account of his observations on the ants, says: "These ants seem at first sight to lead the happiest of existences. Protected by their stings, they fear no foe. Habitations

full of food are provided for them to commence housekeeping with, and cups of nectar and luscious fruits await them every day. But there is a reverse to the picture. In the dry season on the plains the acacias cease to grow. No young leaves are produced, and the old glands do not secrete honey. Then want and hunger overtake the ants that have revelled in luxury all the wet season; many of the thorns are depopulated, and only a few ants live through the season of scarcity. As soon, however, as the first rains set in, the trees throw out numerous vigorous shoots, and the ants multiply again with astonishing rapidity." From Belt's most interesting account, we learn that the ants do not have it all their own way, and it is probable that the period of food scarcity during the dry season has its salutary effect, holding in check the excessive increase of the ants, and only permitting the strongest to survive. The value of such a standing army to the tree is very great, protecting its foliage from the depredations of grazing animals, as well as from the onslaughts of the leaf-cutting or parasol ants which work such destruction in tropical South America. It is a most extraordinary sight to

watch an army of the leaf-cutters at work, stripping the foliage from an unprotected tree. A great column of the ants may be seen marching from their nest to the tree, up which they ascend and spread to every branch. Each ant in a very few minutes, with the aid of its powerful jaws, snips off a circular piece of leaf about the size of a sixpence, and marches off with it back to the nest. So that if you stand near the route to and from the nest, you will see a double column of these extraordinary insects, one outward bound, eagerly pressing forward to the doomed tree, the other returning, each member carrying its piece of leaf. These leaf-cutting ants are not confined to tropical South America, for they are great trouble in some parts of Asia, and in the province of Canton in China it is the custom of the natives to protect their orange-trees from the depredations of the leaf-cutters by placing the nests of harmless, tree-inhabiting ants amongst the branches.

I am inclined to think after some years of careful observation of the habits of our own common large Wood Ant (*Formica rufa*), that its services have not yet been fully appreciated as a tree protector. The first time my attention

was drawn to this was some years ago when visiting a plantation of firs very badly attacked by sawfly larvæ. A stream flowing through the plantation cut off one part in which the nests of the wood ant were very numerous, while in the other part there were only one or two, the rest having been exterminated by the game-keeper digging them up to get at the pupæ, the so-called ants' eggs, to feed his pheasant chicks. That part of the plantation in which the nests abounded was practically uninjured by the sawfly infestation, while in the other the trees were very badly attacked by the larvæ. Since then I have had many opportunities of watching these ants at work, ascending and descending the trees, bringing down from the branches and carrying off into their nests innumerable larvæ of sawflies as well as of different Lepidoptera, and most successfully clearing the trees of these foliage-destroying foes.

Just now the gardener is busy clearing some of the ground in the kitchen garden in preparation for planting out his winter greens. Perhaps this does not seem a very likely situation in which to seek for interesting subjects, or in which we are particularly likely to be con-

fronted with fresh problems. But experience will teach us that the answer to many an unsolved riddle lies beneath the most unsuspected material and apparently unpromising surroundings. Let us examine the roots of some of those bean-plants which the gardener has just dug up and thrown on one side. We shall find attached to the roots many small rounded swellings or tubercles, varying in size from a pin's head to the size of a pea. If we cut some of these nodules off and cut little thin slices, or crush one, and place under the microscope, and examine our preparation with a high power, we shall find that instead of the tissues of a rootlet there are crowds of minute rod-like bodies—bacteria. If we would further satisfy ourselves that these nodules are not normal parts of the plant, we can do so by growing some seeds of the bean in soil that has been calcined at a high temperature, or in well-boiled water, where no nodules will be formed upon the roots. If, however, we transplant our seedlings, or introduce into the soil or water in which they are growing some of these nodules, then in a short time the roots will begin to develop tubercles, while the plants will

acquire a new vigour and an increase in nitrogenous substances greater than is proportionate with the amount of nitrogenous salts present in the soil. These experiments show that the nodules are not part of the normal root of the plant, but that they are receptacles filled with bacteria; that the presence of these micro-organisms instead of being harmful is advantageous to the plant, and that apparently by the aid of this partnership the bean plant and other leguminous plants and cereals upon whose roots these tubercles are to be found, are able to utilize the free nitrogen of the air. So, after all, the kitchen garden holds secrets of the web of life for us.

Down in the orchard we may learn yet another interesting lesson about the web of life. On the trunks and branches of the old apple-trees, and forming beautiful patches of colour on the mossy stone wall, are numerous growths of lichen. I am afraid that because these tinted growths are to be found on every ancient wall and tree trunk, and are therefore such familiar everyday objects, most of us are apt to pass them by without a second thought, or perhaps dismiss them from further consideration beyond

the casual remark that such a tree or stone has a pretty lichenous growth upon it. Suddenly asked, "What is a lichen?" we are rather stumped for a reply, or may vaguely answer, "A plant, of course." Certainly to most people they are still regarded as definite individual plants forming a well-marked group, yet every lichen is really an example of helpful partnership between two plants, an alga and a fungus, a condition of life to which De Barz has applied the term Symbiosis, which means, literally, living together. De Barz's suggestion that the many resemblances shown by lichens to both algæ and fungi might really be due to an admixture of these two constituents, aroused a storm of opposition from the systematists and lichenologists who for years had revelled in the labour of creating new species and classifications, to the creating of a voluminous and unwieldy literature on the subject. However, Schwendener, the pupil of De Barz, took up the challenge of the systematists, and devoted himself to the suggestion formulated by his master, with the result that it was not long ere he was able to prove the correctness of De Barz's statement, isolating from the fungus-

like tissues of a lichen the little greenish cells of an alga, which lived and multiplied after they had been isolated. But let us hear his own account of this wonderful discovery. "As the result of my researches," writes Schwendener, "all these growths (lichens) are not simple plants, not individuals in the ordinary sense of the word; they are rather colonies consisting of hundreds and thousands of individuals, among which, however, one predominates, while the rest in perpetual captivity prepare nutriment for themselves and their master. This master is a fungus, a parasite which is accustomed to live upon others' work; its slaves are green algæ, which it has sought out, or indeed caught hold of and compelled into its service. It surrounds them, as a spider its prey, with a fibrous net of narrow meshes, which is gradually converted into an impenetrable covering; but while the spider sucks its prey and leaves it dead, the fungus incites the algæ found in its net to more rapid activity, indeed, to more vigorous increase." Monsieur Bornet has not only full confirmed, but extended the results of Schwendener's researches, proving that a single "lichen" may really con-

tain three or four distinct species of algæ, which have been overrun and woven into a false tissue by the fungus.

We must be careful in the course of our investigations not to confuse symbiosis, a partnership which in the main is one of benefit to both parties, with parasitism, in which the association is harmful to one of the parties. Two examples of parasitism which we can observe for ourselves during our country rambles are the Dodder and the Mistletoe. The Dodder we shall find living as a parasite upon clover, hops and nettle, a strange-looking plant, leafless, wan and twisting in spirals closely round its host. It is an annual, dying away in the autumn, after it has flowered, and the matured seeds have burst explosively from the seed receptacles and been farther scattered by the wind. Throughout the winter and early spring, these seeds lie dormant on the ground, protected by decaying leaves, which also form a suitable bed for them to germinate in. Not until the hops or nettles have made some appreciable growth of stem does the dodder seed show any signs of active germination, then a little club-shaped root is pushed out and enters the soil, while

the young stem remains covered by the seed husks which contain a store of nutriment. The thread-like stem then begins to grow, drawing the necessary materials for its growth from the seed store until it is exhausted. As the stem grows it sweeps in circles as if seeking for some support to which it may cling, and these movements continue for a little time after the store of food contained in the seed has become exhausted. If, however, by this time no supporting plant-stem has come within its reach, the dodder lies prostrate on the ground, dormant and helpless, and in a few weeks perishes. Should, as is more often the case, the circling dodder stem in its ever-widening sweep touch a plant-stem, a hop or a nettle, it twines round, and soon gives off attaching papillæ, by which it firmly attaches itself to its host. These papillæ penetrate the rind of the host stem, sending out numerous rootlets, which grow down into close connection with the bast portion of the stem, penetrating the vessels of the bast which carry down to the roots the complex organic substances that have been formed in the leaves, and absorbing these

materials. In this way the dodder flourishes at the expense of its host, and continues its twining growth with renewed vigour, and once it has firmly established itself, its base dies away, so that it is no longer connected with the soil, but twining round its host, continues to produce papillæ through which the dodder absorbs the ready-made organic substances it is incapable of manufacturing for itself.

As the Autumn advances, the mistletoe becomes more and more conspicuous, its bright green stem and leaves standing out in contrast against the leafless branches of its host. In England it is most frequently to be found growing upon old apple- and pear-trees, in orchards and meadows frequented by thrushes, and upon the black poplar. It is essentially a plant the study of whose life-history can best be started during the Autumn and Winter. It is at this season of the year that its beautiful white berries are so conspicuous, and so tempting to the thrushes; indeed, these birds act as the distributing agents for the dispersal of the seeds. So we may watch our friends the thrushes, particularly the Missel Thrush, which has

gained its name from its fondness for the berries, feasting upon the shining, opalescent fruit, which contains the small, hard, indigestible seeds embedded in a sticky pulp. While some of the seeds will pass through the birds uninjured on to the branches of the trees, some will adhere to the beak and toes of the thrush, who will get rid of them, when he has a clean-up after his feast, by rubbing them off on to the branches of the tree, the sticky pulp being sufficient to hold them in place. A little root then grows out from the seed, and coming in contact with the branch expands into a clinging disc. This disc in turn develops a modified rootlet which pierces the bark and reaches the wood, and brings to a close further growth during that year. In the following spring the growth of the new wood of the host encloses the rootlet of the parasite, which also increases in length. During the second year the rootlet gives off lateral branches which grow longitudinally between the wood and the outer rind, giving off other rootlets, in proportion to the number of which the parasite flourishes and increases in stem and leaf. As the roots spread along between the wood and outer rind, fresh

stems arise, so that from a single seed numerous branches of mistletoe may be produced. The rootlets from their position not only firmly anchor the parasite to its host, but absorb water and salts from it, while the stem and leaves of the mistletoe spread out, and in the light and air carry on the same functions as the green stems and leaves of any other plant. Therefore, the mistletoe is only partially dependent upon its host for some of its complex food stuffs, and is practically a natural graft, rather than a true parasite like the dodder, which, as we have seen, is totally dependent upon its host.

In our search we shall find that there are several plants which display a habit of partial parasitism. In the shaded woods we may find the delicate-looking Cow-wheat (*Melampyrum*), with its pale, yellow, snapdragon-like flowers. On digging it up carefully along with the other plants growing just round it, we shall find that the roots of the Cow-wheat are at intervals tightly attached to those of the other plants, by means of modified discs which send suckers into the host-roots. The Louseworts, the Yellow-rattles, and the Eyebright or Euphrasy may be included in this category, and will afford us

material for further observation. So throughout the year we may pursue our studies, each subject leading us on, widening the prospect, yielding fresh problems, new and unsuspected strands in the web of life.

CHAPTER XIII

THE FALL OF THE LEAF

"A sound of fluttering leaves begins to run
From side to side."

As we stand on the brow of the hill the slanting rays of the Autumn sunshine suck up the last grey mist wreaths from the valley, and bathe the weald in a flood of golden light. The soft morning air sweeps up and fans our faces, bringing the sound of lowing kine. Overhead, a tiny speck in the deep blue vault of the heavens, a lark is pouring forth its matins. The perfect peace and hush of an Autumn morning rests upon the landscape, and fills the heart with a feeling of deep contentment, tinged with an undefinable regret. Looking at the quiet, peaceful scene Tennyson's beautiful lines, so full of tender pathos, form naturally upon our lips—

"Tears, idle tears, I know not what they mean,
Tears from the depth of some divine despair

Rise in the heart, and gather to the eyes,
In looking on the happy autumn fields,
And thinking of the days that are no more."

Is not this shadowy sadness in our hearts but a response to the deeper sorrow of Demeter the great Earth-Mother; whose presence we feel so near to us on this still Autumn morning, as she looks out across the mellowing landscape, which tells of the swiftly-approaching hour when she must once more part from Persephone? So with one last half-regretful, lingering glance at the peaceful scene stretching away into the distant blue haze of the South Downs, we turn and follow the old Pilgrims' Way as it winds down through the beech woods now glorious in their autumn dress of russet and gold, onward towards Canterbury and good Becket's tomb—pilgrims ourselves along Life's winding way that leads us, trusting, hopeful, at last to that silent bourne from which no traveller returns.

As we enter the beech wood we find the winding pathway covered with golden, scarlet and brown leaves, Nature's many-hued carpet spread for the feet of departing Persephone. What of the story these golden and brown

VERTICAL SECTION THROUGH STEM, RESTING BUD, AND LEAF-STALK, SHOWING THE DARK BAND OF THE PARTITION MEMBRANE

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leaves, fluttering earthward on the Autumn wind, have to tell? Throughout the Summer they have been busy, living their intense life, thriving in the hot sunshine, producing stores of food now laid up in reserve in different parts of the plant. Now the chill breath of Autumn has checked their vitality, the supplies of water are no longer rising through the stem; transpiration and the flow of the sap grow less and less, and gradually the leaves begin to die. But as their life ebbs, they surrender all that remains within their tissues of sugar and more complex materials to the tree which bore them. While these residues of the leaf's life flow back into the parent stem, preparation is being made for the fall of the leaf. Slowly but surely across the base of the leaf-stalk, in a region which is normally firm and hard, an inward partition of soft juicy cells is forming, actively multiplying and expanding, daily weakening the point of attachment, until dead leaf and living stem are bound together by but a few remaining delicate fibres. Nature has been at work like a skilful surgeon, securing every vessel, so that when the leaf shall finally be severed the parent tree shall not

bleed to death. While this partition membrane is growing, a wondrous decomposition product has been forming, a veritable pigment of death, replacing the living matter that was passing slowly inwards from the leaf, and staining the withered tissues of the leaf to glorious tones of orange, purple, golden yellow and crimson red. And now, all things completed, the leaves, still beautiful in their death, fall gently from the trees, or are finally severed by the Autumn gales, and carried in swirling eddies through the woodland. Over the last broken strands the partition membrane closes and forms the complete protective scar, so that all may be well with the parent tree, and no loss of reserve material from gaping wounds take place. The dead, fallen leaves drift backwards and forwards, withered, faded and torn, the sport of the Autumn and Winter gales, until at last, rain-soddened and heavy, they accumulate upon the ground, to moulder away through the action of fungi and bacteria, to be covered up by earth-worms, and at last form the soft, good mould from which the seedlings of another year shall arise at the bidding of

Demeter, to deck the earth afresh with verdure.

As we wander through the Autumn woods, innumerable fungi attract our attention, varied in form, and often vivid-coloured, offering new problems for elucidation. Destitute of chlorophyll, they are unable to use the carbonic acid gas of the air, as all green plants do, and must therefore depend upon ready-made supplies of organic matter, and live as parasites upon living vegetable or animal hosts, or as saprophytes on decaying matter. So by their aid the fallen leaves and branches are mouldered away, and the death of the storm-maimed tree is hastened, the spores of the fungi finding lodgment in the wounds caused by the breaking of the branches by the violent Winter gales, and spreading inwards to the heartwood of the tree. The decaying tree affords shelter and food for innumerable larvæ and beetles, which fatten on the decaying tissues, and in turn are sought out by the woodpecker. Finally the tree falls, and its mouldering fragments pass into the earth, forming the soil from which its offspring shall arise. So once more, in the

autumn woodland, comes the vision of the web of life, reminding us that—

> "Like some wise artist, Nature gives
> Thro' all her works, to each that lives
> A hint of somewhat unexprest."

THE BRIGHT-EYED ROBIN ON THE GARDEN POST WILL CHEER US IN THE DARK WINTER DAYS

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CHAPTER XIV

THE PASSING OF PERSEPHONE

"Through the gaunt woods the winds are shrilling cold,
Down from the rifted wrack the sunbeam pours."

THE harvest is safely gathered in, and save for the low sighing of the Autumn wind through the stubble of the deserted fields, a heavy silence is settling over valley and hillside. Away in the west great masses of cloud are piled high, through which the setting sun sends angry shafts of light, which show up in vivid contrast the russet and gold of the oak and beech in the copse leading to the sombre, sinister darkness of the pine wood at the foot of the hill. The path leading to the dark entrance of the pine wood is thick with fallen leaves, that ever and anon are stirred as if by unseen footsteps, or, caught in a sudden eddy of wind, go dancing, swirling madly into the forest gloom, a phantom procession of the glory of the year, heralds of the passing of Persephone. All day long cattle, sheep and

birds have called to each other across the open fields, with anxious restlessness, their voices awakening an answering echo from the hills. So all day we have sat at our study table by the open window, making vain effort to accomplish the day's task, hourly finding it more impossible, with that call from woodland and meadow ringing in our ears, until at last we have thrown down our pen and rushed from the house and climbed the hillside, that we, too, may draw nearer to witness the departure of Persephone. The puffs of wind have gradually died away and the leaves no longer stir. Out of the gathering silence comes the faint, half-frightened call of a migrant bird, winging its southward journey, and our old faithful hound shoves a wet nose into our hands and gives a low, soft whimper; for he, too, feels the magic of the hour. Deeper and deeper grows the silence, until one's pulsing blood rings like a hammer stroke through the brain, and every nerve tingles in response to the coming storm. Not a breath stirs, though the great towers of cloud are spreading and glowing in the west. Every moment the tension on one's nerves increases, unseen hand seem

to touch and thrill you through and through. Look at the old hound crouching at our feet, how the hair bristles erect on the ridge of his back and shoulders, and ever and anon a shudder passes down his lithe body, and his teeth gleam white, but never a sound escapes him. He, too, feels the touch of those hands and unseen presence which seem to wrap us round, incapable of articulate sound or movement. Out of the west comes a low rumble as of the approach of distant chariot wheels, then all is still again, save for the throbbing of our pulses. See, a little ghost-like mist-wreath has formed in the meadow, near the sheltered bank where the first flowers of the year bloom, and is drifting slowly towards the woodland path leading to the dark pines and the brooding storm beyond; Nature's silvery canopy, hiding, shielding from human sight, Persephone, as she passes from the empty fields. Now the rumble of those mighty chariot wheels grows every instant nearer, and great sword-like flashes strike earthward, or writhe in and out the storm-cloud like fiery serpents. The tension is at last released, and Nature becomes vocal once more, giving tongue to the roaring

of the winds. The old hound no longer trembles, but snarls back defiance at the storm. See, the gates of the storm-wind have flung backwards, and a roar as of many waters comes to us as the escaped winds strike the edge of the forest and set the branches wildly tossing. Away goes our hat down the wind, and the first drops of the swiftly approaching rain strike like whip thongs against the face. A vivid flash that almost blinds us, followed instantly by crashing thunder that seems to shake the very foundations of the hills, and the storm bursts in all its fury upon us. Like the hissing of a great army of angry serpents, the rain and hail sweeps down, blotting out the landscape. The wind whirls shrieking past, carrying clouds of leaves, and the sound of snapping, rending branches. Flash of lightning and crash of thunder follow each other with appalling swiftness, so that the whole earth seems to rock and sway with the violence of the storm, and almost deafened, stunned and blinded by this titanic warfare, we are thankful enough to seek even such dubious shelter as the crumbling walls of a ruined barn may afford. And so, as swiftly as it came,

the great autumn storm departs, sweeping down the valley, until at last the rumble of the wheels of those mighty cloud-chariots is lost in far distances.

Once more stillness falls upon woodland and valley, but not the happy quietude of the summer evenings. Far down the valley a dog gives vent to a long-drawn, dismal howl, that rings across the deserted, rain-soaked fields, and fills them with an added loneliness. A slip of a moon rides high in the clear, cold, rain-washed sky, and a chill wind moans through the reeds bordering the mill-stream and among the battered branches of the trees. Mist wreaths gather in the water-meadows, now no longer tenanted by soft-eyed, sweet-breathed cattle. And ever and anon comes the sound of that sad-voiced wind, sweeping over moorland and forest, hillside and valley, the voice of Demeter, the great Earth-Mother, carried on the wings of the Autumn gales, mourning the departure of Persephone. And now for many weeks we shall wander through the fields at the sunset hour, feeling a loneliness, as of the absence of a dear companion. The Autumn gales, sweeping across the country,

will soon bare the trees of their last remaining leaves, so that the old Elms in the hedgerows stand out gaunt, with waving, naked arms, against the lurid sunset, weird, witch-like forms. Gradually the nights grow longer, and the air colder, Jack Frost drawing his delicate ice patterns upon the windows and the surface of the mill-pond, until one morning we awaken to find all the earth covered with a pure white mantle of snow, and Winter reigns supreme over woodland and valley, hill and dale. Our footsteps ring clear on the hard, frost-bound road, as we tramp briskly along, and friend Robin, from his favourite perch on the gate-post, greets us with his cheerful song. Climbing the Down, we look out across the Weald all white and peaceful. The sun bursts forth flooding the whole scene with sparkling radiance—

"And Winter slumbering in the open air,
Wears on his smiling face a dream of Spring!'

Tramping home through the gathering twilight, our breath steaming in the crisp, frosty air, we pass under the shadow of the old grey church tower, from which comes forth the

WINTER'S WHITE MANTLE IN THE WOODS

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merry peal of Christmas bells, carrying their glad promise of peace and goodwill. Let us just for a moment step inside and watch the sturdy bell-ringers at their pleasant task. By the light of his old lanthorn old Will gives them their lead. And so to it they go with all their might as if determined this Christmastide to—

"Ring out the false, ring in the true."

Home at last, tired limbs stretched to the comforting warmth of the firelight, which is sending dancing light amongst the teacups, and great fluttering shadows across the ceiling, we discuss the beauties of a Winter day's ramble. And later, when the candles are lit and a pleasant warmth and light fills the study, we gather round the fire, and to the accompaniment of the rumbling of the wind in the chimney, talk over pleasant days and experiences by stream and woodland of the past Summer, helping our memories by reference to photographs, sketch- and note-book. And so, as old Sam Pepys would have had it in his diary, had he been a lover of Nature, to bed, greatly uplifted, determined that each succeeding year

shall find us striving to keep within us the simple, humble, questioning heart of a little child, by which we may ever draw nearer to the great truths of Nature, and by which alone we can hope to truthfully say—

"In Nature's infinite book of secrecy
I can a little read."

THE END

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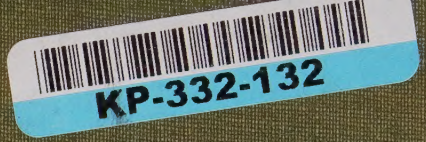
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